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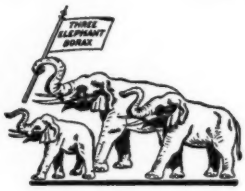

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VOLUME XXIX NO. 7

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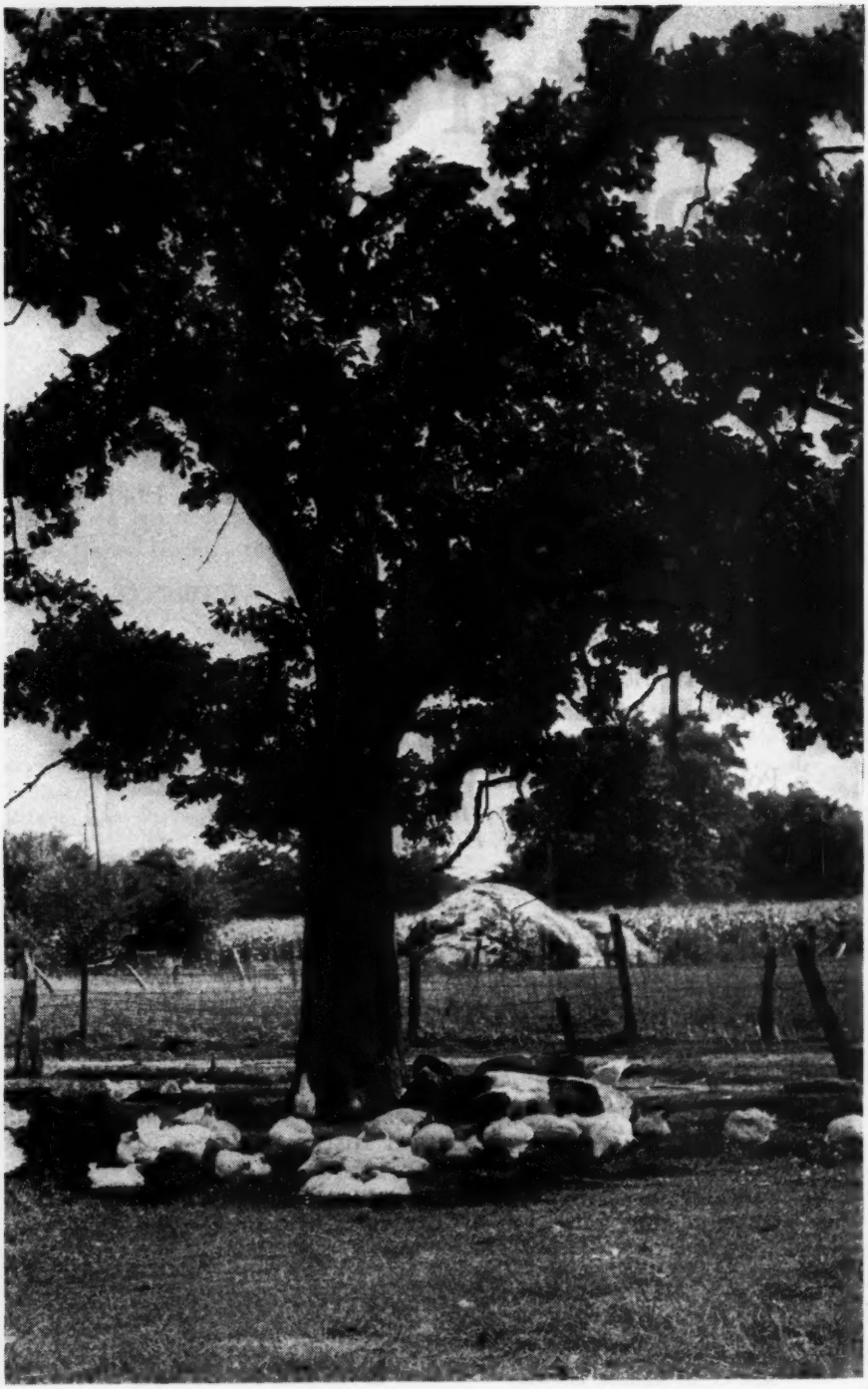

AUGUST SIESTA

Better Crops with PLANT FOOD

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VOL. XXIX WASHINGTON, D. C., AUG.-SEPT., 1945 No. 7

Science Speaking

Jeff McDermid

I PRESUME a chap who sets himself up as a translator should be able to understand the language of the pitcher and the catcher with like facility, even when they resort to idiom. I raise this sixty-four dollar question largely because a number of my regular audience are likewise happily engaged in serving as mail-order go-betweens to connect the dispenser of accumulated science with the hungry horde of folks who eagerly utilize the crumbs from the rich research storehouse, to make ends meet in every-day life.

I expect that I am not entirely fitted to tackle this synopsis on science as she is being peddled to the layman. I boast no official degrees or even shirt-tail seminars in the scientific classroom and laboratory. I have been a sort of artful dodger meanwhile, grabbing off what I could snitch from the garbage cans and cast-off rummage sales of scientific odds-and-ends, to serve them up in a dish of salvaged tissues, fats, and oils for jaded or constipated mental appetites.

However, I have been at this blind-man's bluff antic quite a number of moons, come next Sunday. I have acquired all the caution, secretiveness, and furtiveness inherent in this merry chase for newer knowledge of what ails us and the plants and soil, and how to find a ready remedy. I began it all with a wrong-end-to approach to the original McCollum vitamin discovery back in the early days of college research in human nutrition. I thought at the time that the main idea was to get the dope broadcast. (I refer to newspapers as we enjoyed no wireless then.) I was caught up short in this illusion, and came very close to being dispensed with. Instead of pleasing the raw and unlettered masses first, my task really was to please McCollum; and by satisfying his standards of what a release should

contain, I would thereby garner for him no grudges among fellow scientists and also have a true picture to unfold to weary sufferers from rickets, scurvy, beriberi, and black tongue.

To draw a fine distinction between blatant over-dramatized copy and miserable weasel words and atom-paring phrases was thus firmly brought to my attention, with a blue dismissal envelope used as "background material." They did not desire a circus promoter or a carnival poster clairvoyant, but a guy with some balance and due respect for precedent, modified language, and a dash of dignified restraint. I wish to resume discussion anon in this epistle about weasel-wording and atom-paring terms used in scientific forecasts, but I now proceed without further interruption, unless you fall asleep.

Beginning with the technique of presentation, a short review of research literature shows there are generally two kinds of offerings edited for the printer. Some say neither kind really makes the farmer sit up late at night or causes him to lay aside the almanac or old Doc Snide's Cow Disease Book so as to peruse them.

BE that as it is, the college editors label one kind of treatise a technical research bulletin and the other is a so-called popular circular. Just how popular leaves ample room for an old-fashioned debate with no holds barred. If you mean popular in contrast to the other kind, amen.

Of course, let's be fair and render justice when a square deal doesn't cost anything extra. The technical research issues are not intended for geezers with limping vocabularies and no love or admiration for deep-breath words of sixteen syllables. These books are prepared mostly for rival scientists and library lingerers. Like lawyers' briefs, these manuscripts begin with considerable annotated history and footnoted precedent and gradually work up to a climax, such as it is, on the last page.

I give an example of one where the title contained seven words, with only one I could grasp—tomato. Shifting names a trifle, so as to make this insulting to nobody living or dead, here it is:

"In 1939 Baker and Todd described the resistance of lycopersicon pimpinellifolium Mill, accession 60, to the tomato fungus, Fusarium oxysporum f. lycopersici (Sacc.) Snyder and Hamilton." And at the end, "a race of Fusarium oxysporum f. lycopersici has been isolated which appears to have a distinctive type of pathogenicity."

OR take another erudite transfusion: "A negative correlation was found between the number of fibers per square millimeter and the area of the stem. This coefficient is highly significant, as the 1 per cent level of significance is 0.128."

Now I realize that man-to-man across the laboratory table such language is pure and convincing and, above all, exact and conclusive. I also know that if we advertised farm machinery with graphs and diagrams and reports by mechanical engineers we would be serving up just as difficult reading matter. Somebody with technical lingo and shop idioms must converse and contribute to one another's progress or we get nowhere in the realm of dreams and discovery. The main quarrel one has with institutions for dishing up technical facts is in the mailing and distribution departments. Such stuff should be kept secret from the taxpayers and stockholders, with not much risk that anybody would ask for a peek. You wouldn't need to infer to them that they lacked brains to read it, but just keep them in ignorance of its existence. That's a successful old Army game.

But there is still another point to be considered about these communications designed strictly for absorption by fellow scientists. I believe in cases where a translation is not desirable for the public, some inkling of the scope of the work involved and the serious and painstaking labor and training required might well go to the layman.

I just unearthed a voluminous publication processed in the Department of

Agriculture covering 275 pages or more. It plunged in great detail into the whole gamut of formal and informal reports on the species and families of plants which have toxic or repellent qualities toward insects. Its breadth of treatment and inclusive character, as well as its lists of plants, trees, and shrubs with botanical names, meant a headache to

casual scanners. But get this point, it seems to me that the public should be aware of the patient trial and error method by means of which the entomologists and botanists follow through on a veritable Indian trail in the jungle to sample each leaf and root and herb, natural and dried, for signs of insect control capacity.

When I read the introduction and learned that between Roman times and the twentieth century only three plants with highly efficient insect-damaging qualities had been discovered—hellebore, pyrethrum, and nicotine—it seemed all the more remarkable that man still persists in his eternal search and sifting to gain these ends. That's exactly why a smart go-between guy should never reject a technical treatise until he wrings out of it something to encourage science and to cause the public to respect scientific workers with as much fervor as they display toward movie stars and ball players.

After all, we've a task before us to debunk the popular myth which the dear tax-paying public retains in regard to the research career man. The farmer is so used to seeing and hearing the jolly, backslapping, story-telling extensionist that he never gets to clearly know the cloistered savants who produce most of the rabbits the extension fellows pull out of hats. An extension man will tell an audience all the current know-how and what-is-it about livestock diseases and epidemics, but it's the laboratory brother in the rubber apron, back there behind the scenes, who gets the express packages of vulcanized intestines and spotted livers to diagnose and find a quick remedy for. Then when he finally emerges from the abattoir with problem solved, the researcher gets blamed for using high-falutin' lingo with little or no credit for absorbing all the smells and taking all the overtime.

I don't dare carry this one right into that old argument of the educational ages, as to how things would fare if the positions were suddenly reversed for a trial heat, and the extension man went into the kitchen and the research worker burned up highway gas, as well as other kinds. But I can vouch for the writing fraternity, that *we* don't feel technically capable of undertaking the experiment, much as we chide the test-tube boys for so much inorganic language. Privately, however, I know research workers who can tell awfully plain, understandable stories with a down-to-earth smack to them, before they shift gears and go into a trance. That's what roils me up about research, this dual personality idea.

NOT so long ago a group of college and extension editors met in Washington and during their convention they held a session with one of the key research men in the Department of Agriculture. They came away encouraged no end over the forthright attitude of this leader respecting the desirability of issuing plain-spoken and direct information to the public, who in the long run will put the stuff to a real acid test.

He said that the story of research must be told fairly, clearly, and accurately. He believes in frequent reports concerning the steps being taken to gain results, even though the final grand objective is neither won nor lost. He wants folks who help pay for the re-

(*Turn to page* 50)

Plowing under organic matter in October, when fully mature, insures maximum beneficial effect.

Plow-Under Practices

By B. A. Rockwell

Farm Bureau Cooperative Association, Harrisburg, Pennsylvania

THE importance of organic matter in maintaining soil fertility has been recognized. In the writings of Pliny and Cato in the early Roman era, there was manifest a serious concern about the waning soil fertility. To a considerable degree, this condition was believed to have resulted from failure to maintain the organic matter content of the soils. The growing of green manure crops and full utilization of plant waste for incorporation into the soil which they urged differed only in degree of use in practice and method of incorporation to that employed in this country. The Romans could not plow under because the moldboard plow was unknown. The prevailing practice in this country has always been to plow under.

Whether full and complete incorporation of organic matter as we practice it is better than the less complete incorporation as employed by the Romans prompts me to relate some personal observations and experiences. An incident which occurred some eight years ago has led me to conclude that under no circumstances should green succulent plant material be plowed under during the hot summer months. The discovery, which I made by accident rather than planned procedure, initiated what thinking I have done on the subject of plowing under. Here is my story.

The Annual Pennsylvania Potato Growers' Convention had been scheduled to take place at Hershey, Pennsylvania, during the third week in July

1937. Being employed by the Hershey Farms at the time, it became my duty to arrange a two-day program for visiting growers. Since a number of farm implement dealers were to have exhibits, a nice level plot of ground was provided for demonstrating tillage tools and tractor operation. One of the features of the program was to plow under or attempt to plow under a rank growth of soybeans. The soil on which the soybeans were growing was a Berks shale.

The various types of plows which entered this plow-under contest were as follows: three bottom, two bottom, and single bottom moldboard. The three-bottom plow accomplished nothing since it clogged up and bogged down within 20 feet from the start. The two-bottom did only a little better than the three and was forced to give up in a very short distance. Finally, along came a single 18-inch bottom moldboard with a chain. After the first furrow was opened this plow did an excellent job, actually turned under the rank growth of green organic matter, and continued to operate until four furrows had been plowed. Since it was the third week in July, hot summer weather prevailed but there was sufficient soil moisture to facilitate good plowing.

About three weeks later I decided to visit the demonstration field and determine if possible the degree of decomposition of the green soybeans that had been plowed under. I attempted to dig into the soil with my hands, dog fashion, which usually can be done on this somewhat loose shale type of soil, but painfully discovered that the human hand could make no impression since the soil had baked. After securing a sturdy garden trowel, digging three holes in three different locations, and finding no decaying organic matter, only some black streaks of ash-like substance here and there, I became quite perturbed. I was absolutely certain that I had witnessed the plowing under of green soybeans, yet I could find no material evidence.

That evening, in the quiet of my home, the mystery began to clear. I recalled the explanations for what is likely to happen when hay is placed in a mow containing too much moisture—heat, mow burning, and when the moisture content of hay in the mow is too high and the air is excluded, the heat may reach the point of ignition and hay

A group observes a newly developed attachment to the plow which places the fertilizer in a band on the bottom of the furrow.

John Daniel of Hershey, Pennsylvania, produced 743 bu. of potatoes to the acre by applying, band-method, a 7-21-21 fertilizer.

and barn may be completely destroyed by fire. Fundamentally then, the same destructive forces, only much more accentuated, were brought into operation when the green soybeans were plowed under. The green soybeans had a higher moisture content than any semi-cured hay and they were turned under with air largely excluded, the correct combination to generate heat. In addition this turned-over soil was exposed to the hot rays of the sun. Consequently, it is not difficult to understand why the green soybeans became so hot that they actually burned up, leaving only a few dark streaks of ash scattered throughout the soil which was baked to almost brick hardness. Therefore, practically all of the important physical benefits of the organic matter were lost and perhaps some of the plant nutrients as well, especially nitrogen.

In this connection, let us reflect for a moment on the much publicized benefits to the soil from incorporation of organic matter. Briefly it is reputed to (a) make soils loose and friable, (b) induce better aeration, (c) maintain more uniform soil temperature, (d) increase water-absorbing and holding capacities, (e) help prevent erosion, (f) stimulate bacterial action, and (g) increase efficiency of commercial fertilizers, particularly phosphoric acid and potash.

Desirable as all of these benefits are in any soil management program, it seems quite clear that they cannot be expected to obtain under any system which induces their rapid dispersion. Certainly, if organic matter will do what scientists claim and outstanding farm practice has demonstrated, there is urgent need for reconsideration of our recommendations on how to secure maximum benefits from its use.

In my own personal experience in comparing the moldboard plow with the disk for the best handling of green manure crops and other plant waste, six years of intensive study have convinced me that to the greater extent we can replace the plow with the disk, the more nearly the maximum benefits of organic matter will be achieved. The ideal handling of organic matter in farm practice, as I see it, not only dictates a more general use of the disk, but delay in incorporating the material into the soil until the plants are fully matured.

The literature on fertilizer research indicates that scientists are thoroughly

In this wheat field, fertilizer was not applied to one drill width. On either side an 0-10-10 fertilizer was applied at the rate of 300 lbs. per acre.

sold on the desirability of maintaining the organic content of soils. The benefits resulting from favorable influences on the physical, chemical, and biological relationships are stressed. These relationships, together with the improved moisture conditions and more uniform soil temperatures, enter largely in the matter of fertilizer efficiency. Conspicuous among the benefits of organic matter is its buffer action or capacity to neutralize, within limits, either acids or bases without changing the original acidity or alkalinity. This characteristic is particularly advantageous on soils low in phosphorus or having a high-fixing capacity for this element.

But organic matter also, especially in the rapidly decaying stage, is reputed to have considerable value in releasing soil potash. In times of a critical potash shortage, such as in World War I, there may have been an element of sound logic in attempting to release soil potash by this means. However, when considered from the standpoint of normal times when potash supplies are adequate, and with the knowledge that the over-all best influence of organic matter results from practices which prevent rapid decay, other means of supplying the needed potash for plant growth should be used.

Since the last World War, we have gone a long way and learned much relative to the importance of potash in crop production. This is reflected in tonnage figures for the country as a whole. In 1913, for example, there were only 250,000 tons K_2O used, while for the year 1944 the tonnage was considerable in excess of 600,000 tons K_2O. Such a change in tonnage is the best evidence obtainable to indicate the futility of depending upon the small release resulting from the action of organic matter on soil reserves. It seems to convince even the most skeptical layman or scientist that research has come into its own, despite the apostles of old, and some still with us, whose lime-phosphate-manure philosophy has failed to maintain the high level of fertility necessary for the most economic production of crops on vast acreages of American farm soils.

As a layman, perhaps my growing consciousness of the importance of potash can best be attributed to my extensive studies at the Hershey Farms. From 1930 until 1944 I was engaged

by them as Director of Agricultural Research. The operations comprised of 7,500 acres of cultivated land which was receiving the manure from 1,000 cows, 500 head of young stock, 500-600 hogs, 300 horses and mules, 4,000 hens and, some years from 200-300 steers. This vast amount of manure had been supplemented in most instances with superphosphate. Soil liming was also a general practice. In 1936, when I began to collect soil samples for our chemist, most of them from soils of limestone origin and some shale and sandy loam, I received a real jolt when results of these analyses came back. Ninety per cent of the first 100 samples showed insufficient available potash to produce a crop economically. For quite some time afterward, analyses of soil samples collected followed the same pattern, always low in available potash.

Of course, these analyses obtained from the soil chemist prompted the use of more potash salts with very gratifying results, which are summed up briefly as follows: John Daniel had been growing potatoes for the Hershey Industrial School for 25 years but had never been able to produce 400 bushels to the acre. However, as soon as he began to use sufficient quantities of fertilizer containing 21 per cent potash, his best analysis was a 7-21-21, he hit the "jack pot" and has been able to produce 400 bushels to the acre and even more (over 700 bushels some years) nearly every year since. Cooking quality of the potatoes was greatly improved. Improved cultural practices, better seed, and methods of fertilizer application also contributed to increased yield, but even so, we cannot lose sight of the important role played by potash for it was this element that constituted the weak link in our fertility chain.

Increased yields of corn with better quality were obtained. There was less lodging, brighter straw, earlier maturity, larger yields to the acre, and more weight per bushel for small grains. More legume hay in the barns and more legumes in the pastures, and last but not least, tree vigor accompanied by increased yield, improvement in color, and quality in apples, all resulted from the increased use of potash where much less or none had been used before. Thus it is evident that potash had been a limiting factor in the production of many crops on the Hershey Farms.

What the increased use of potash did for the Hershey Farms it will do for many other farms in the Northeast. Even though the use of potash has very materially increased in recent years, there are still many, many farmers in the State and throughout the Nation who could increase their net earnings by using more potash in their fertility program. Until such action is taken, soil management, especially with the heavy type soils, should insure all possible benefit from the natural soil potash. This can best be accomplished by plowing or disking down green manure crops that have been permitted to mature fully. They will decompose slowly and gradually liberate their potash content, as well as aid release of some natural potash.

Fertilizer Efficiency

No discussion of plow-under practices would be complete without some thought of fertilizer efficiency in our crop production program. Experience has shown that for maximum efficiency from use of fertilizers we not only must make sure we use the right amount of the right fertilizer ratio, but we must apply it at the right time and in the right place with respect to the feeding root.

Fertilizers broadcast on prepared seed-bed and disked or harrowed in, or, as in row crops, sown by hand or machine under or along with the seed are not conducive to efficient use. The broadcast fertilizer, particularly phosphorus and potash, being widely distributed and in intimate contact with the soil particles tends to become chemically fixed and therefore less available to the plants. In close contact with seed in row crops it may seriously retard growth or even injure the crop. Thus,

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The Effect of Borax and Lime On Quality of Cauliflowers

By Russell Coleman and F. J. LeBeau

Mississippi State College, State College, Mississippi

IN an effort to determine the effect of borax and lime upon the yield and quality of cauliflowers, a field experiment was conducted in which cauliflowers were fertilized with different amounts of lime and borax. Soon after the cauliflowers were planted, many of the plants were killed by cold weather, and the stand was so irregular that the yields were of no value. However, there was a marked difference in the quality of the cauliflowers which survived; many of the plants showed symptoms of boron deficiency, while many others were normal. A detailed study was made of the extent to which each plant was damaged by a lack of boron, and the cauliflowers were classed into five groups depending upon whether they were normal, slightly damaged, moderately damaged, badly damaged, or severely damaged. Plants showing symptoms of boron deficiency were dwarfed and showed different degrees of browning.

The results in Table 1 show the number of plants which occurred in each group. The index gives an average quality value for the cauliflowers from each treatment. Where no borax or lime was applied, many of the plants showed symptoms of boron deficiency and a considerable number of the plants showed severe damage from a lack of boron. Where 20 pounds of borax were applied to the soil, most of the cauliflowers were normal and only a few showed any symptoms of boron deficiency. Where 40 pounds of borax were applied, none of the plants showed boron-deficiency symptoms, but many of them were damaged because of too much borax. These results show that 20 pounds of borax applied alone definitely improved the quality of cauliflowers.

Hollow stem in cauliflower caused by boron deficiency.

Applications of lime, either 4,000 or 1,500 pounds per acre, greatly increased the number of plants which showed boron deficiency. Where lime was applied alone, a high percentage of the plants were seriously injured by a lack of boron and only a small percentage of the cauliflower plants were normal. However, when 20 pounds of borax were

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Potash Fertilizers Are Needed On Many Midwestern Farms

By G. N. Hoffer

Lafayette, Indiana

THE need for more potash in the production of Midwestern crops is becoming more apparent each year. Even though sales of potash fertilizers are reflecting an increased demand, many crops in widely spread areas are still showing the deficiency symptoms of potash hunger and starvation. Potash is needed particularly for muck crops; for crops on alkaline soils; for crops on soils that have been limed, phosphated, and otherwise inadequately fertilized over a period of time. But the use of potash is only one step in the whole process of good farming.

Successful farming requires the closest understanding of and cooperation with Nature. Agricultural research is directed constantly to learning more and more of the unchanging biological principles governing the production of crops as well as animals. Better crops and animals are produced by applying these principles and helping the unaided handiwork of Nature. The art of farming handed down from father to son is rapidly becoming the science of farming. However, farmers have been and are still selling their soil fertility capital and calling it profit.

Actual profits from the use of lime, manure, phosphates and potash fertil-

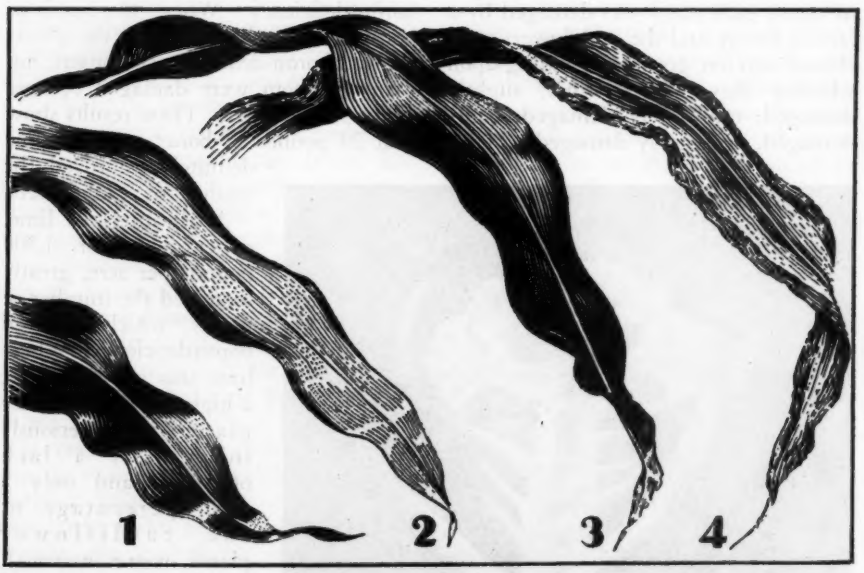

Fig. 1. Typical effects of plant food hunger, contrasted with normal leaf. No. 1—A healthy corn leaf; No. 2—Nitrogen starvation; No. 3—Phosphorus deficiency, chiefly indicated by a purplish hue, often very noticeable on under side as well as top, and a "firing" of the leaf tip; No. 4—potash hunger.

Fig. 2. Root rots weakened the potash-starved plants in foreground. They are in an experimental plot that received only nitrogen and phosphate fertilizers over a period of years. Plants in right background received potash in addition.

izers depend upon the information obtained from all sources. Soil tests indicate the available plant nutrients already in the soil. They point to the need of supplementary applications of fertilizers for maximum yields of nutritious crops. Growers are also becoming acquainted with the symptoms of plant-nutrient deficiencies, not only of potash, but of nitrogen, phosphorus, boron, magnesium, manganese, and others which are appearing in many crops in various soils in this territory. A deficiency of any one of these nutrients may limit profits and lead toward bankruptcy unless remedial measures are applied.

Due to the constant losses of soil fertility caused by erosion, crop removals, leaching, loss of organic matter, and the failure of some growers to fertilize their crops adequately, practically all crops in the Midwestern and Eastern states respond to fertilizers of some kind when used properly. The common appearance of potash-deficiency symptoms in many crops is mute but striking evidence that further supplementary changes in fertilizer usage are needed. Fortunately the symptoms developed by plants which indicate their distress when the supply of potash begins to fail are remarkably reliable and cannot be disregarded by growers who wish to continue to produce crops profitably. They become important when used as a guide in planning a soil management and crop rotation program.

There has been an assumption for years that most Midwestern soils contained unlimited amounts of potassium. Soil analyses indicated a total content up to 40,000 pounds of potassium per acre. Because of this chemical evidence, agricultural authorities believed and stated that this supply in these soils would last for many years of crop pro-

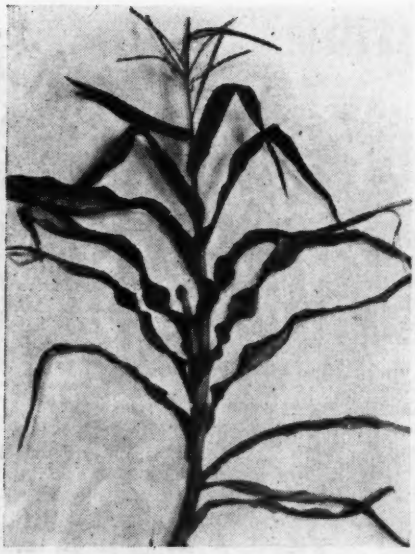

Fig. 3. Corn plant badly starved for potash. Note short internodes and marginal scorch of long, lifeless leaves.

duction. Now it is known that the total amount of potassium in the soil does not reflect accurately either the amount of physiologically available or replaceable potash for plant growth. Studying the rate of release of potassium in fertile soils, agricultural workers show that the relative rate of liberation of potassium from soil minerals determines the continued richness of the soil. A high rate of liberation will maintain a high level of available potash, and vice versa. These rates, of course, vary in different soils, but they determine the supplies of potash naturally available for the crops.

To illustrate, Scarseth has aptly described the significance of "available potash" by stating that if you stood leaning against the wall of the First National Bank which had a million dollars in its vaults, and you had only fifty cents in your pocket, there would be a total of one million dollars and fifty cents within the circle of the bank and you. As for you, fifty cents would be available for your immediate use. Thus, it is for the soil potassium. The total supply means little. What is actually available for the crops really counts.

This question of how much potas-

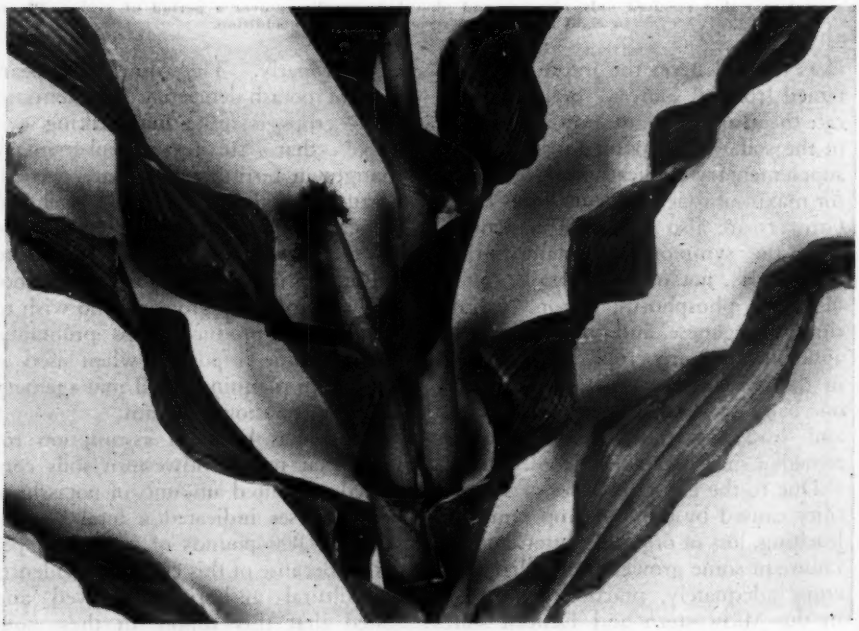

Fig. 4. Close-up of potash-starved corn plant. Note yellow-streaked, marginal-fired leaves.

sium is actually available in different soils is receiving much attention at the present time. In January 1936, Professor R. H. Bray of the University of Illinois made a very important statement regarding the dwindling supplies of available potassium in Midwestern soils where the practice of liming, phosphating, and the growing of legumes was followed. He stated, in part, as follows . . . "The old belief that Illinois soils contained plenty of potash which could be made available by proper farming methods has now been definitely discarded. Much of the potash in our soils is 'inexhaustible' only because it is so tightly locked up that the plants cannot obtain it in amounts sufficient for good growth. No system of farming or treatment practice is known which will markedly affect the yearly rate at which potash becomes available to crops. Potash deficiencies are showing up more and more in the last few years, and it is predicted that certain soil areas of the State not now considered generally deficient will become so within a short period. The suspicion thrown on the Illinois system of agriculture, which has been blamed for these potash deficiencies, has been definitely put down. It is not the system of agriculture but the soils themselves which are at fault. " Just as you cannot run a Lincoln with the amount of gas required by an Austin, so you cannot obtain good crops from certain of our soils with a soil potash supply insufficient for even fair crops. The use of potash in most of the Southern and Southwestern soil areas, if good crops are desired, is inevitable. It can be avoided only by being satisfied with low crop yields or returning in the form of manure practically all in the crops taken off. The use of potash fertilizers or return of manure where possible on our deficient and partially deficient

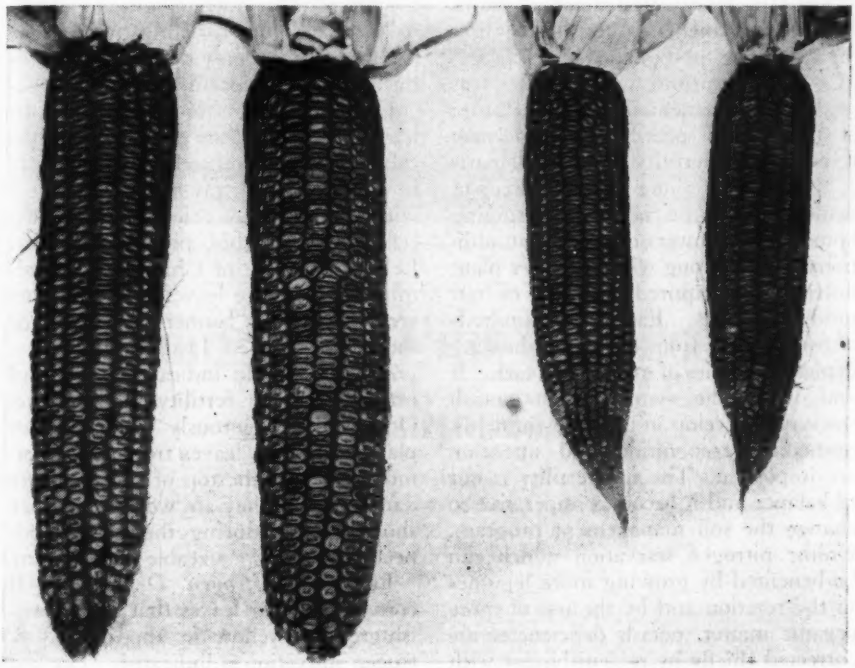

Fig. 5. Ears to left are from plants receiving nitrogen, phosphate, and potash fertilizer; right, from plants receiving nitrogen and phosphate only. Tapering ears indicate potash deficiency.

soils, where other factors are not lacking, should be encouraged. Many farmers, not understanding their potash deficiency, have decided to let well-limed and phosphated land revert to pasture or weeds, whereas the use of potash would make those fields the richest on their farm. Liming the soil helps conserve the available potash against leaching and yet does not interfere with the crop's ability to take it up."

Thus the Midwestern system of maintaining permanent soil fertility by liming, applying phosphate, growing legumes, and returning crop residues was officially supplemented by the inclusion of the use of potash where needed. Experimental fertility plots in all parts of the Midwest along with hundreds of demonstrations on farms are bringing home to the growers of crops that additional potash along with the other plant nutrients is required in most of our productive soils. Each year hundreds of tests of soils from farms are showing depleted supplies of available potash. If and when the symptoms of potash starvation develop in the crops in fields, immediate recognition and attention are important. The soil fertility is out of balance and it becomes imperative to change the soil management program. Unlike nitrogen starvation which can be benefited by growing more legumes in the rotation and by the use of more organic matter, potash deficiencies are corrected chiefly by replenishment with actual potash fertilizers.

Potash Indicator Crops

In the Midwest certain crops are more suitable to serve as indicator plants to detect approaching deficiencies of potash than others. Corn plants and all of the legumes develop definite symptoms that are very reliable. The leaves of grains and grasses are rather small to use for visual diagnostic purposes. Radishes and cucumbers show distinct symptoms.

Since corn is the chief crop grown in the Midwest and the symptoms displayed by corn plants serve admirably to detect the level of available nutrient supplies in soils, they will be described in detail. One advantage is that when deficiencies are indicated by corn plants, not only they but all of the other crops grown in rotation with the corn will respond to corrective soil treatments. The significance of the symptoms indicating deficient nitrogen and phosphates in relation to potash will be discussed. After all, a program of soil management and fertilization which includes the use of plant nutrients in adequately balanced amounts for all of the crops in a rotation is the only one that will produce satisfactory profits.

Figure I shows four types of corn leaves which illustrate degrees of healthfulness and mineral soil deficiencies. It is difficult to portray these symptoms without the use of color, but these excellent pen sketches, prepared by Mrs. LeRoy T. Goble of Chicago, serve admirably. If these leaves of corn plants are regarded as "banners" of merit for the growers, then Leaf 1, *a healthy, green leaf,* would indicate a successful program of soil fertility maintenance. On healthy, vigorously growing corn plants all of the leaves from the lowermost leaves to the top of the plant are dark green. They are working as they should, in producing the plant foods needed to mature sizeable ears of corn.

Leaf 2 — *Nitrogen Deficiency* — If corn plants bear leaves that are yellowish-green to yellow in appearance, nitrogen starvation is indicated. The leaf blades begin to turn orange-yellow at the tips and the yellowing follows the midribs. The affected tissues later become dry. All of the leaves on the plants are affected when the deficiency of nitrogen is severe. Frequently corn growers make the mistake of attributing nitrogen starvation as due to dry weather. This symptom is quite common on sandy soils low in organic matter. It indicates a dwindling organic matter content in other soils. Corrective measures are the introduction of more legumes in the rotation, the use of more manure, the return of crop residues, and the use of supplementary ni-

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A bulldozer speeded the transition from forest to truck farm.

From Scrub Pine to Broccoli On Cape Cod

By Bertram Tomlinson

County Agricultural Agent, Barnstable, Massachusetts

ONE hundred and twenty acres of broccoli, more than half of all produced in Massachusetts, are now grown on Cape Cod, an area perhaps known best for its world-famous cranberries and its wonderful vacation land, with its miles of fine beaches and sand dunes. Another interesting fact about these acres of Cape Cod broccoli is that they are found on one great farm, which in a short span of three years has become one of the best known vegetable farms in the Northeast.

The farm referred to is known as Veg-Acre Farms, owned and operated by William Richards. It is located in the village of Forestdale in the town of Sandwich and is bounded on the south and west by Camp Edwards. When purchased by Mr. Richards in the fall of 1940, it was known as Bear Hollow Farm and for over 20 years had been operated successfully as a dairy farm. The soil is technically described as Merrimac very fine sandy loam, medium to heavy phase. It is characterized by friable surface soil and a compact subsoil. The surface soil varies in depth from six to nine inches while the subsoil, a yellowish-brown to a yellow silty clay loam, extends to a depth of 30 to 36 inches where it changes to a coarse sand and gravel, providing fine drainage. It's just about an ideal soil for vegetable gardening for it works up nicely and requires no long waits between rains in order to dry out and get in good condition for tillage operations.

At the time the farm was purchased in 1940, it contained about 800 acres of land of which there were about 120 acres cleared and these had been used previously for the production of silage corn, pasture, and hay. The entire block of land is in one solid piece and most of it is as level as a meadow, which makes it well adapted to the use of all kinds of farm machinery. Scrub pine and oak were growing on the uncleared areas, and the first job Mr. Richards tackled was to clear a 75-acre piece of this growth in the summer of 1941.

The land clearing was done by the use of a seven-ton bulldozer, caterpillar tread, which was equipped with a mechanical lift. After pushing the trees aside, the land was broken with a breaker plow, cutting a furrow 12 inches deep and 22 inches wide.

After plowing a deep tillage tool was hooked up to the caterpillar tractor and this was run lengthwise of the furrows, then crosswise, an operation that not only loosened the subsoil but also cut roots into 2-foot pieces, making it easier to clear them out of the fields.

In order to fit this virgin woodland soil for broccoli production, Mr. Richards applied two tons ground limestone to the acre before plowing and the same amount was harrowed in after plowing along with an application of 20% superphosphate, one ton to the acre, and 600 lbs. of muriate of potash (60%). That's the procedure for the first season; as Mr. Richards puts it, "to produce crops right off the bat." This heavy rate of liming increased the pH from 5.0 to 6.5, the desired reaction in preparing the land for broccoli. Part of this new land was then planted to sweet corn, and immediately after the corn was harvested, the green fodder was plowed under to provide an additional amount of organic matter for broccoli. Mr. Richards is a great believer in feeding crops. "There is one thing I won't economize on," he said, in discussing the subject of fertilization, "and that is fertilizer. I always plan to use plenty because I know from experience you can't grow big crops on a half-starved soil." After the land is first cleared and treated as above indicated, he has a similar intensive system for subsequent fertilization. He specifies 2½ tons ground limestone to the acre after plowing, harrowing it in, and adding a ton of mixed fertilizer, a ton of

A heavy-duty, deep-tillage tool helped put the newly broken soil into garden-like condition.

There is a farm taxi service from coldframes to field. Three trucks are kept busy supplying one planter.

superphosphate, and 600 lbs. of potash.

He uses a special mixture of his own which approximates a 5-10-10 analysis, each ton of which includes 70 lbs. of manganese sulphate, 70 lbs. iron sulphate, and 10 lbs. of borax. This is used at the rate of from 1 to 1½ tons per acre and is harrowed in. No row applications are made with complete fertilizers, but side-dressings of nitrate are used whenever necessary to bring the crops along properly.

Spring yields of broccoli run around 400 crates (12 bunches per crate) to the acre and fall crops at about 250 crates, which indicate pretty well that the fertilizer program must be about right. In fact, three years ago chemical tests made on soil samples taken all over the farm showed that they were not only very acid (pH 4.5 to 5.0), but also very low in available nitrogen, phosphorus, and potassium, while now tests made on these same fields give very high content of these plant nutrients.

Of course, there are many other factors involved in growing a fine grade of broccoli on a large scale. For example, it must be kept growing rapidly throughout the season and that means an edequate supply of moisture must be available in the soil or it must be supplied by irrigation.

Here again, we come to admire the farm location, for it includes a nice fresh water pond, providing not only a good supply of water for irrigation purposes but also a nice place to fish and swim when time permits.

The irrigation system consists of modern light-weight metal pipes with instant-type couplers and revolving sprinkler heads. The pump has a capacity of 11,000 gallons per minute. Eight-inch pipes make up the main irrigation lines of which there are 5,000 feet, and the laterals consist of 7,400 feet of six-inch pipe, and 1,800 feet of four-inch pipe. Rotary nozzles are spaced 40 feet apart and the lateral lines, 70 feet. The water has to be pumped over an 80-foot bank and so pressure at the pump is maintained at 100 to 115 lbs. per square inch to allow for a loss in elevating water to the fields. An inch of water can be applied to the crops in an hour and a quarter. This system was used extensively during the extreme drouth of 1944, which was one of the driest seasons on record.

Organic matter in the soil is built in through the systematic use of such green manure crops as domestic rye grass and winter rye. Cover-crop seedings made before September 1 are domestic rye grass seeded at the rate of 40 lbs. to the acre and a half-ton of fertilizer is used, approximately 5-10-10. Quite often this is done as one operation, with the seeder following the harrow, and behind this a cultipacker. Winter rye is used in late fall seedings. Mr. Richards is a great believer in the value of green manure crops and is arranging his rotation so he can get back to his standard practice in Rhode Island of plowing under 7-foot sudan grass to supply maximum organic matter between cash crops. "You can certainly see the difference in the way the next crop comes along, following such a heavy green manure crop," he commented.

Spring broccoli plants are started in the greenhouse about February 1, then moved out to heated coldframes early in March where they are hardened and ready for field planting early in April. Two-row planting machines are used in setting out these plants in the fields and one machine keeps three small flat-top trucks busy hauling plants from the coldframes to the planting machine. Rows are spaced about three feet apart and plants 18 inches in the row. Fall broccoli plants are started in seedbeds in the field and transplanted early in August.

Careful Market Preparation

Other factors in the success of this interesting enterprise are the method of harvesting, grading, and packing broccoli and in all these operations one can observe the same care and thoroughness that went into its production. The broccoli is brought in from the fields in insulated van-type trucks to a large packing house. Here, the workers stand around long benches grading and bunching under the constant supervision of Mr. Richards and his two foremen. Nothing but the best is bunched and when packed into crates, each bunch carries an attractive wrapper, giving the brand name as well as suggestions for cooking. Each crate passes through an ice water bath and comes out to a platform where parchment linings are added and a generous quantity of snow ice is placed in each crate in order to keep the product cool while in transit. After packaging, the crates are nailed and loaded in van trucks for the 80-mile trip to Boston, where they arrive with the ice still in the package.

Mr. Richards has developed his own strain of Green Sprouting broccoli by careful plant selection and breeding. Some strains have been developed particularly for spring planting and others for the fall crop, indicating again that nothing is left to chance when it is possible to use a scientific method of improvement.

There are many other interesting details that could be discussed in connection with the operations at Veg-Acre Farms, for other specialties include spring- and fall-harvested spinach, iceberg lettuce, turban squash, sweet corn, lima beans, and potatoes.

William Richards, now known to hundreds of farmers as "Bill," is not a farm-raised boy. He was born and brought up in the city of Boston and his earliest experience in agriculture dates back to the first World War. When as a boy Victory Gardener he got his first experience planting a vegetable garden in that city under the instruction of his school principal, Charles L. M. Lamphrey.

Apparently, he never thought much about this experience at the time for he completed his high school education and then went to the Massachusetts Institute of Technology where he graduated in 1927 as a chemical engineer. Shortly afterwards he joined the research staff of the Studebaker Automobile Company and while testing out cars became interested in automobile racing. He was quite successful at that, too, for on one occasion he was within seconds of winning a prize of several thousands of dollars, but Fate inter-

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Clover comes to maturity in the border area between the two plots where wheat was cut out early to eliminate competition for soil fertility. On the right, an annual application of limestone and three tons of manure was made.

Red Clover Suggests Shortage of Potash

By William A. Albrecht

University of Missouri, Columbia, Missouri

COMPETITION by the associated wheat as nurse crop with red clover for the limited fertility in the soil was sufficient on Sanborn Field to give a poor clover crop in the wheat stubble (shown at the left in the illustration), but a very good crop in the border of the plot where the green wheat was cut out in trimming the plot to proper size.

This poor red clover crop in the stubble occurred in the 6-year rotation of corn, oats, wheat, clover, timothy, and timothy where lime had been applied about five years ago, and where the equivalent of three tons of manure had been applied annually since 1888. In spite of rotation to reduce the rate of soil exhaustion during the past 55 years, this soil that grew clover fairly well at the outset of the experiments on this field is now so low in its delivery of fertility that the wheat, as the nurse crop, is too much competition for the red clover. The soil is no longer able to grow a wheat crop and start the clover at the same time. The elimination of the nurse crop by cutting it out of the border was the difference between a good crop of red clover in the border area and one in the stubbles that was about to be "smothered out" by the growth of weeds, if not killed out by the "bad weather."

Barnyard manure had been helping the clover in this crop rotation even before lime was used. Lime and manure had given good clover. Those facts suggest that we need to look to the low supply of potassium in the soil as partly responsible for clover failures. Barnyard manure is low in phosphorus but

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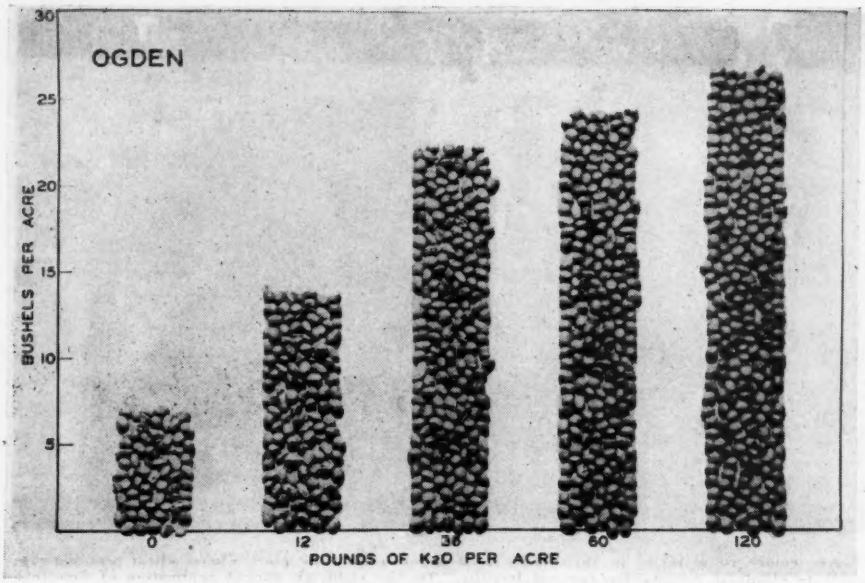

Fig. 1. Potash increased the yield of Ogden soybeans on Coxville very fine sandy loam.

Fertilizing for Better Soybeans In North Carolina

By W. L. Nelson and W. E. Colwell

Agricultural Experiment Station, Raleigh, North Carolina

APPROXIMATELY 300,000 acres of soybeans are grown for seed in North Carolina with more than 90 per cent of this acreage in the Coastal Plain. The use of fertilizer for soybeans is not a common practice. To make the situation more acute the majority of the soybeans are in rotation with corn, a crop which frequently receives but little fertilizer or lime. As a consequence of this system, the yields of soybeans are on the down grade in spite of improved varieties. The average State yield is in the neighborhood of 12 bushels per acre.

Experimental work on the fertilization of soybeans was conducted at several locations in 1944, with particular emphasis being placed on potash, magnesium, and limestone. In addition, exploratory experiments with minor elements were carried on. In recent years it was observed that areas of beans in certain fields retained their green leaves at harvest, and closer examination showed very few pods on the plants. The removal of one or more of the nutrient elements by continued cropping with soybeans was considered a possibility.

Coxville very fine sandy loam (Beaufort County) was selected for a study of potash and magnesium response on the basis of observation of severe potash deficiency and dying of soybeans the

TABLE 1.—YIELD AND QUALITY OF SOYBEANS (OGDEN) GROWN IN COXVILLE VERY FINE SANDY LOAM

Treatment*		Yield	Poor quality beans
K_2O	MgO		
Lbs/A	Lbs/A	Bu/A	Per cent by weight
1..... 0	36	7.1	37.2
2..... 12	36	14.0	28.6
3..... 36	36	22.6	10.0
4..... 60	36	24.7	9.6
5.....120	36	27.1	3.1
6.....120	0	20.3	3.3
7.....120	12	25.4	1.3
8.....120	60	26.5	3.2
9.....120	36 (no Ca)		
L.S.D. (.05)		2.6	

	Milliequivalents per 100 gms. of soil					
	Base exchange capacity	Ca	Mg	K	P_2O_5-lbs./A	O. M.-%
Soil pH analysis** 5.0	6.84	2.40	.15	.026	66	2.3

* Base fertilization of 24 lbs. of P_2O_5 from treble superphosphate and 300 lbs. of gypsum in the row with exception of treatment 9 which received no gypsum. K_2O from 62 per cent muriate of potash and MgO from magnesium sulfate side-dressed before the first cultivation.

** Analyses made under the supervision of J. R. Piland, Associate Soil Chemist. Exchange capacity and exchangeable bases by ammonium acetate extraction. P_2O_5 was extracted with .002N H_2SO_4.

previous year. The soybeans referred to had received no fertilizer. The corn ahead of them had been fertilized with 200 pounds of 5-7-5 per acre.

Before planting in 1944, the experimental block received a base application of phosphorus and calcium. Variables with respect to potash and magnesium were introduced. For example, with a magnesium treatment considered to be adequate, four rates of potash were compared to a no-potash treatment. Similarly, with a potash treatment considered to be adequate, three rates of magnesium were compared to a no-magnesium treatment. It is evident from the results presented in Table 1 and Figures 1, 2, and 3 that both potash and magnesium exerted beneficial effects. For instance, yields were increased from 7.1 bushels per acre with no potash to 24.7 bushels per acre with 60 pounds of K_2O. An additional 60 pounds of K_2O further increased yields only 2.4 bushels. Potash-deficiency symptoms were acute on the leaves of the soybeans receiving 0, 12, and 36 pounds of K_2O per acre. The height of plants at harvest was 17.5 inches with no potash and 25.5 inches with 120 pounds K_2O. The greater part of the beans grown at the low potash rates ripened prematurely and were moldy, misshapen, shrunken, and off color (Figure 2). Mechanical separation into classes of good and poor quality beans showed 37.2 per cent by weight of poor quality beans with no potash added and only 3.1 per cent with 120 pounds of K_2O (Table 1). This soil was very low in exchangeable potash, containing .026 m.e.

Previous work ([1]) showed a marked increase in yield of beans from applications of 16 to 32 pounds of K_2O per

[1] North Carolina Agricultural Experiment Station. Unpublished results. 1925-1931.

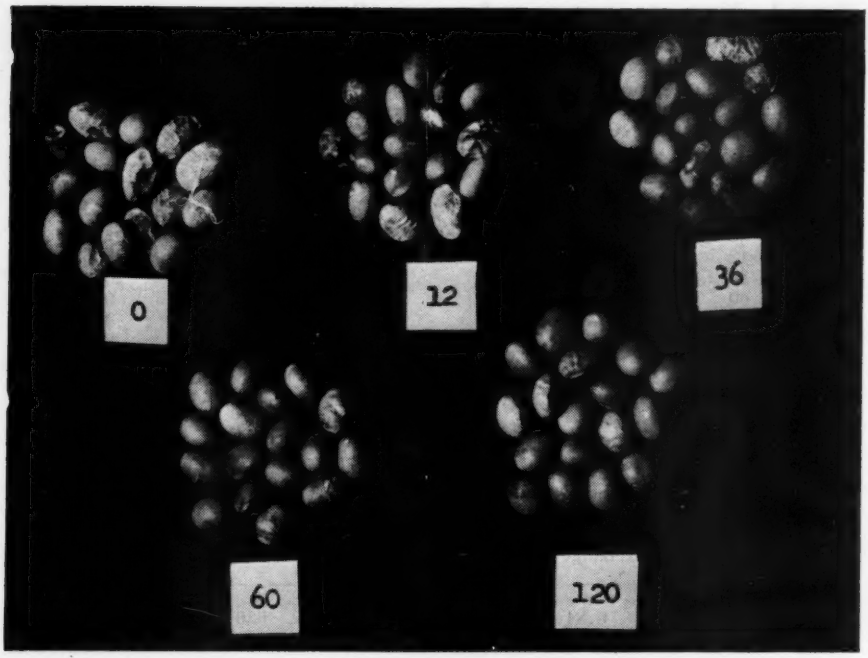

Fig. 2. Potash improved the quality of Ogden soybeans grown on Coxville very fine sandy loam. (Potash expressed in lbs. of K_2O per acre).

acre. Experiments in 1943 ([2]) gave increases in yield from 36 pounds of K_2O per acre, but no significant further increases from 60 pounds of K_2O. The 1943 experiments were conducted on the dark-colored soils of the Lower Coastal Plain, two on the Portsmouth series, and one on Dunbar. The surface soils contained .06 to .08 m.e. of exchangeable potassium (56-75 pounds of K_2O per acre).

From the standpoint of magnesium, it will be noticed in Table 1 and Figure 3 that 12 pounds of MgO (from magnesium sulfate) increased the yield of soybeans 5.1 bushels per acre. Higher rates gave little benefit. Magnesium-deficiency symptoms were quite prevalent on the soybeans receiving 0, 12, and 36 pounds MgO with 120 pounds of K_2O. There were no symptoms on the soybeans receiving 36 pounds MgO and 60 pounds of K_2O, however. Magnesium did not affect quality. This soil was relatively low in exchangeable magnesium, .15 m.e. (60 pounds MgO per acre).

A comparison of the yields of treatments Nos. 8 and 9 shows that there was no benefit from the added calcium.

The same type of experiment was located on an upland soil of light texture, Norfolk loamy sand (Pitt County). Soybeans grown on this field the year previous (1943) were observed to have severe potash-deficiency symptoms. They had not been fertilized and neither had a crop of cowpeas and soybean hay in 1942. This soil was very low in exchangeable potash, magnesium, and calcium (Table 2).

On this soil yields were increased from 9.4 bushels per acre with no potash to 18.8 bushels with 36 pounds of K_2O (Table 2). Additional potash up to 120 pounds of K_2O did not further increase yields. Additions of magnesium gave a marked response in yield with 60 pounds of MgO giving an increase of 7.3 bushels per acre. Calcium in the row from gypsum gave no increase in

[2] Colwell, W. E. Fertilizing Soybeans in North Carolina. Better Crops With Plant Food. October 1944.

yield. Yields at this location were limited by lack of rainfall in May and June as only .18 of an inch fell in the period between May 19 and July 1.

Two additional experiments, somewhat different from those discussed above but with primary emphasis on potash and magnesium, were conducted on so-called "soybean soils" of the lower Coastal Plain. Selection of the areas was made without knowledge of potash or magnesium deficiencies the previous year.

This soil, Portsmouth sandy loam (Pamlico County), was planted in beans in 1943 with no fertilization. In 1942 the land was idle. The results of the 1944 experiment presented in Table 3 show that the application of 72 pounds of K_2O per acre increased the yield from 31.1 bushels to 43.0 bushels per acre. The quality of beans was markedly increased by the added potash, and the oil content was increased slightly. There was no response to magnesium and calcium. This soil was relatively high in available magnesium and calcium and low in potassium.

Corn was grown on Bayboro sandy loam (Beaufort County) in 1942 and 1943. Previous to this, however, Irish potatoes had been grown continuously and the heavy fertilization built up the exchangeable potash in the soil to .57 m.e. Additions of potash, magnesium, or calcium did not materially affect yields or oil content of soybeans (Table 3).

A third type of experiment was located on an upland soil of light texture, Norfolk loamy sand (Wilson County), where soybeans had never done particularly well. Variables in respect to magnesium (from the sulfate and from dolomitic limestone) and calcium were established.

The broadcast application of 4,000 pounds per acre of dolomitic limestone materially increased the yields of three varieties of soybeans (Figure 4). A

TABLE 2.—YIELDS OF SOYBEANS (OGDEN) ON NORFOLK LOAMY SAND (PITT COUNTY)

Treatment*		Yield
K_2O	MgO	
Lbs/A	Lbs/A	Bu/A
1..... 0	36	9.4
2..... 12	36	12.9
3..... 36	36	18.8
4..... 60	36	16.8
5.....120	36	15.2
6.....120	0	12.2
7.....120	12	15.5
8.....120	60	19.5
9.....120	36 (no Ca)	18.9
L.S.D. (.05)		2.8

	Milliequivalents per 100 gms. of soil				P_2O_5 Lbs/A	O. M. %
	Base exchange capacity	Ca	Mg	K		
Soil analysis pH 4.8	2.58	.34	.13	.032	246	.7

* Base fertilization of 24 lbs. of P_2O_5 from treble superphosphate and 300 lbs. of gypsum in the row with the exception of treatment 9 which received no gypsum. K_2O from 62 per cent muriate of potash and MgO from magnesium sulfate side-dressed before the first cultivation.

TABLE 3.—YIELD AND OIL CONTENT OF SOYBEANS GROWN ON PORTSMOUTH SANDY LOAM, PAMLICO COUNTY (OGDEN) AND BAYBORO SANDY LOAM, BEAUFORT COUNTY (WOODS YELLOW)

Treatments*			Portsmouth sandy loam		Bayboro sandy loam	
K_2O	MgO	CaO	Yield	Oil content	Yield	Oil content
Lbs/A	Lbs/A	Lbs/A	Bu/A	Per cent	Bu/A	Per cent
1..... 0	36	100	31.1	19.0	25.0	19.4
2.....24	36	100	37.4	19.5	24.4	19.7
3.....48	36	100	36.0	19.9	24.0	20.0
4.....72	36	100	43.0	20.0	22.6	19.4
5.....48	0	100	37.0	20.1	22.9	19.5
6.....48	36	0	38.4		26.4	
7.....48	36	100 ($CaCO_3$)	37.8		23.9	
8..... 0	0	0	30.5	18.9	23.8	19.4
L.S.D. (.05)			5.8		2.9	

Soil analyses...pH	Milliequivalents per 100 gms. of soil				P_2O_5 Lbs/A	O. M. Per cent
	Base exchange capacity	Ca	Mg	K		
Portsmouth...4.6	11.1	3.64	.70	.12	153	3.6
Bayboro.....4.8	22.5	4.92	.83	.57	270	8.8

* 48 lbs. P_2O_5 from treble superphosphate and CaO from gypsum in the row at planting (treatment No. 7 CaO from $CaCO_3$). K_2O from 62 per cent muriate and MgO from magnesium sulphate side-dressed before first cultivation.

side-dressing application of 36 pounds of MgO from magnesium sulfate without lime did not affect yields. This soil was very low in calcium and the response from the limestone was possibly due to the direct nutrient effect of the added calcium. The soil analyzed as follows:

Soil analysis	pH	Milliequivalents per 100 gm. of soil				P_2O_5 Lbs./A	O. M. %
		Base exchange capacity	Ca	Mg	K		
	5.0	1.92	.34	.08	.039	203	.5

Previous results (1) from experiments conducted in 1929-1931 show that broadcast applications of limestone increased yields of soybeans 3-10 bushels per acre. These experiments were conducted largely on the Bladen series with a pH of 5.3-5.6 in the unlimed plots. No other soil data are available. In 1943 (2), however, lime did not give an increase in yield at any of three locations. The pH of the three soils ranged from 4.6 to 5.1 with the degree of calcium saturation varying from 19 to 35

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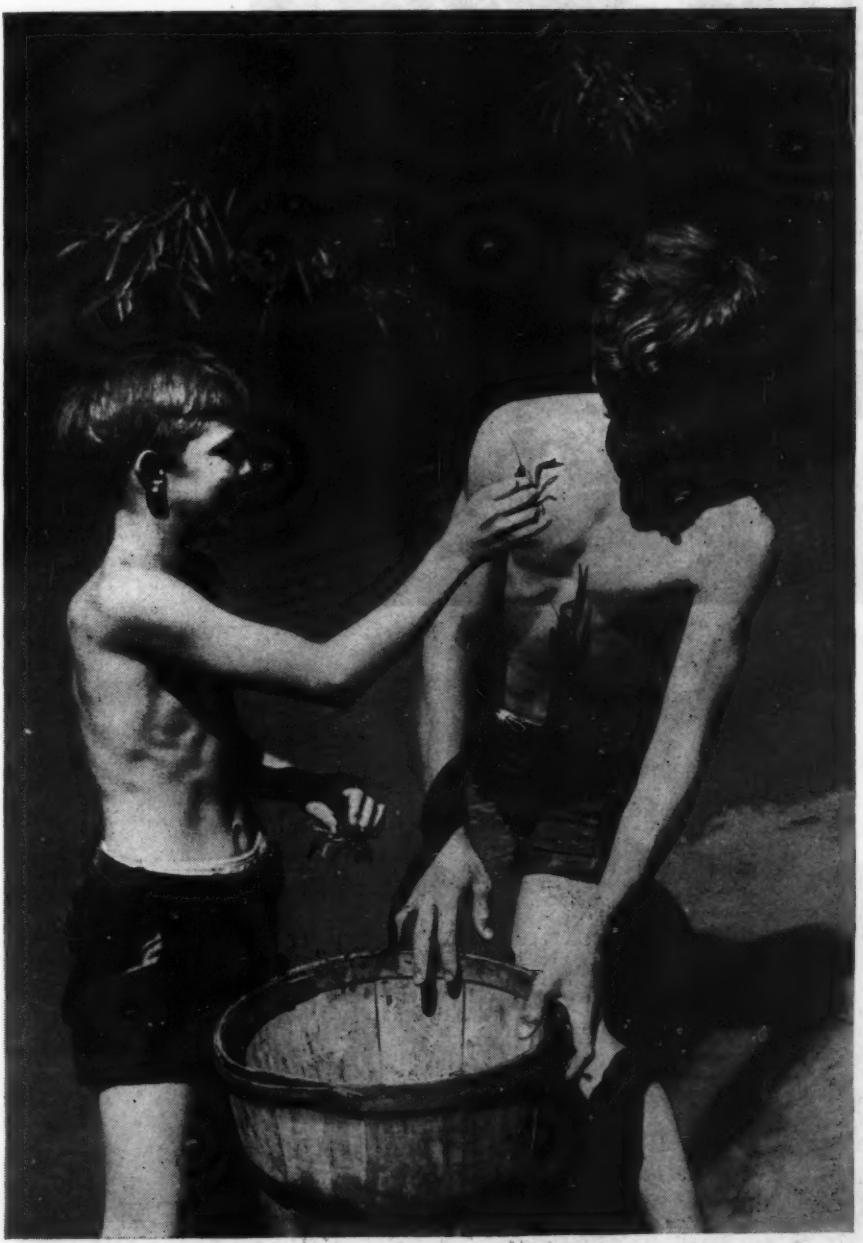
PICTORIAL



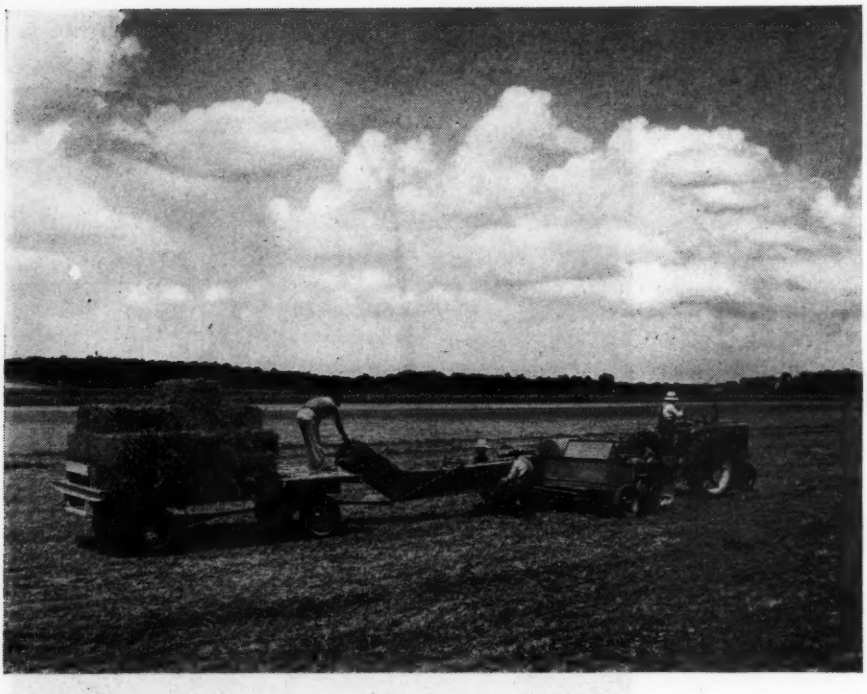
Harmless—if properly handled

Left: The fruits of Victory

Below: Knee-deep in alfalfa

Right: It's good and heavy

Below: Hogs like good pasture



Above: Baling alfalfa that contains about 40 per cent moisture — to be dried in barn later.
Below: Alfalfa baled green and dried in barn as compared to hay handled in ordinary manner.

The Editors Talk

King Cotton Post-war

The fate of King Cotton has been one of the biggest queries in America's post-war planning. Therefore, the talk of Secretary of Agriculture Clinton P. Anderson before the New York Cotton Exchange on August 15 was welcomed for its enlightenment on the subject.

That cotton is king and in this role an important factor in all American lives was emphasized by the fact that between one-quarter and one-third of all farm residents in the United States live on cotton farms. Although they are the lowest income group in agriculture and the lowest of all income groups, about one-third of the cash income of the South comes from cotton—"as cotton goes, so goes the South."

The present American cotton picture includes the paradox of a "much above what is considered normal" carryover of cotton and a "considerable—and sometimes embarrassing"—shortage of cotton fabrics. This paradox can be accounted for with five short words—"Cotton has been to war." Vast quantities were necessarily kept in reserve to meet war needs. Now the first job is to clear the deck of these surpluses, and they already are moving to market.

The Secretary did not overlook the discouraging elements in the cotton picture. He discussed the export market in relationship to the world carry-over of cotton which is at an all-time high and the competition from other fibers and paper. And then he turned to the brighter side.

He sees, first of all, a world ahead that will not be the same world that existed after World War I, or even just before World War II. There is greater agreement, respect, and understanding among the world's leaders than ever before. The world-wide food and agricultural organization holds the possibility of international trade on a new basis.

He counts as a factor for good the new determination to achieve full employment. In this country we have the greatest machine for human betterment the world has ever seen, but it must be used and the products of our labor distributed. He sees a hopeful sign for cotton in the competition for the use of the land. During the war many Southern farmers have made good progress along the lines of diversified farming. Not only have they increased their income—and also their security by not placing all their eggs in a cotton basket—but they have improved their diets, their health, and their outlook on life. The war years have also afforded the South a chance to embark upon greater industrialization.

Another hopeful factor is seen in the constant endeavor to discover new uses for cotton. Much research is continually going on both inside and outside the Department of Agriculture. Among the newer products is an improved cotton tire cord, which possesses increased resistance to heat and bruise-breaks. Much has been accomplished in the production of fireproof cotton insulating material and in the use of cotton in making plastics. Work on mildew-proofing of cotton thread, fabrics, and fish nets, fireproofing of cotton fabrics, and giving cotton goods more eye appeal is going ahead.

Practically all thoughtful persons are agreed that the future of cotton in the South is dependent upon lowering the cost of production so that the price per pound will put cotton in a competitive position on world markets and on the domestic markets with other fibers. This will include better utilization of land for cotton and other crops, improved varieties, better fertilization and other cultural practices, and mechanization. Such procedure will not necessarily mean greater total production, but it will mean more production per acre.

The Department of Agriculture is pledged to cooperate in every way possible in all sound programs to assist the cotton industry, to help increase cotton consumption generally, to enlarge the market for all kinds of cotton. The Secretary feels confident that if we all work together, merging our efforts, our ideas, and our "know-how," we need have no fear of the future of cotton.

Crop Varieties and Nutrient Levels

Like humans, various members of the same family of crops will react differently to various kinds and amounts of food. In many parts of the country, research work is being conducted to determine these reactions. While most of this work is being done with corn, there is no reason to doubt that equally significant relationships of varieties and nutrient levels will be found with other crops.

The corn experiments have been done with the increasingly popular hybrids and have clearly shown that some hybrids will not prove materially better than others at one level of fertility while at another level marked differences may develop. This indicates that if plant breeders are to take full advantage of the capabilities of plants to produce, they should take into consideration fertility levels. Otherwise, it may not be possible to capitalize fully the results of their work.

Too frequently in the past plant breeders have done their work without much attention to the fertility needs of the crop, and by the same token soil investigators have not given proper cognizance to the capacities of the plants they were using to measure the results of their fertilizer work. Fortunately for the American farmer, both plant breeders and soil fertility men are now beginning to recognize that they must work together if maximum results are to be obtained.

The phenomenal rapidity with which the use of corn hybrids has been accepted by farmers probably has been a large factor in bringing together the research groups which formerly went their own ways more or less independently. At one time it was felt that the goal of the plant breeder might well be the development of a strain that would have the ability to grow on poor soil. While there may be a limited field for such work, it is realized that in effect this is merely an acceleration of the soil-mining process which has been all too common in this country. The excellent control which can be provided with plants of known genetic composition has been a means for more sound investigations on the relationship of variety or strain and soil fertility.

Local climatic factors also must be given consideration from both the plant breeder's and soil scientist's viewpoint. The recent work on fertilizer placement is contributing its share to this development since in many cases in the past the beneficial effects of added fertilizers have been nullified by the detrimental effects of the fertilizer either being too close to the plant or so far from the active feeding zone that the plant could not fully utilize the added nutrients.

Probably the full potentialities of proper adaptation of variety and nutrient levels have been only lightly touched and there is every reason to believe that by the cooperation of geneticists and soil scientists much greater efficiency in crop production can be achieved.

Farm Prices of Farm Products*

	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
1910–14 Average	12.4	10.4	69.6	87.6	64.8	88.0	11.94	21.59	....
1920	32.1	17.3	249.5	175.7	144.2	224.1	21.26	51.73	....
1921	12.3	19.5	103.8	118.7	58.7	119.0	12.96	22.18	....
1922	18.9	22.8	96.7	104.8	58.5	103.2	11.68	35.04	....
1923	26.7	19.0	84.1	104.4	80.1	98.9	12.29	43.69	....
1924	27.6	19.0	87.0	137.0	91.2	110.5	13.28	38.34	....
1925	22.1	16.8	113.9	171.6	99.9	151.0	12.54	35.07	....
1926	15.1	17.9	185.7	156.3	69.9	135.1	13.06	27.20	....
1927	15.9	20.7	132.3	114.0	78.8	120.5	12.00	28.56	....
1928	18.6	20.0	82.9	112.3	89.1	113.4	10.63	37.70	....
1929	17.7	18.6	93.7	118.4	87.6	102.7	11.56	34.98	....
1930	12.4	12.9	124.4	115.8	78.0	80.9	11.31	26.25	....
1931	7.6	8.2	72.7	92.9	49.8	48.8	9.76	17.04	....
1932	5.8	10.5	43.3	57.2	28.1	38.8	7.53	9.74	....
1933	8.1	12.9	66.0	59.4	36.5	58.1	6.81	12.32	....
1934	12.0	17.1	68.0	79.1	61.3	79.8	10.67	26.12	....
1935	11.6	16.1	49.4	73.9	77.4	86.4	10.57	35.56	....
1936	11.7	17.2	99.6	85.3	76.7	96.0	8.93	31.78	....
1937	11.1	19.9	88.3	91.8	94.8	107.1	10.36	30.24	....
1938	8.3	17.2	55.5	76.9	49.0	66.1	7.55	21.13	....
1939	8.7	15.4	68.1	75.4	47.6	63.6	6.95	22.17	....
1940	9.6	16.0	70.7	85.2	59.0	73.9	7.62	24.31	....
1941	13.3	26.4	64.6	94.4	64.3	84.0	8.10	35.04	....
1942	18.51	36.9	110.0	108.3	79.5	101.8	10.05	44.42	....
1943	19.84	40.5	149.2	196.7	102.7	127.3	12.82	48.26	....
1944	20.39	41.8	141.0	213.5	113.3	142.8	15.43	52.80	....
July	20.32	45.0	138.0	230.0	117.0	139.0	13.90	53.00	....
August	20.15	39.3	159.0	258.0	117.0	135.0	14.30	53.20	....
September	21.02	42.9	147.0	219.0	116.0	135.0	14.70	52.30	....
October	21.25	41.2	142.0	185.0	113.0	142.0	15.20	52.70	....
November	20.78	45.1	143.0	164.0	106.0	143.0	15.60	53.40	....
December	20.85	43.5	150.0	175.0	106.0	145.0	16.50	53.10	....
1945									
January	20.20	41.9	158.0	190.0	107.0	146.0	17.10	52.80	....
February	19.99	31.8	165.0	201.0	106.0	147.0	17.70	52.70	....
March	20.24	21.4	171.0	207.0	107.0	148.0	18.10	52.00	....
April	20.20	21.4	174.0	211.0	107.0	149.0	16.90	51.90	....
May	20.51	42.2	177.0	214.0	108.0	149.0	16.50	52.10	....
June	20.90	51.2	180.0	220.0	111.0	150.0	15.90	52.50	....
July	21.25	56.3	183.0	230.0	112.0	146.0	15.40	55.00	....
Index Numbers (1910-14 = 100)									
1920	259	166	358	201	223	255	178	240	....
1921	99	187	149	136	91	135	109	103	....
1922	152	219	139	120	90	117	98	162	....
1923	215	183	121	119	124	112	103	202	....
1924	223	183	125	156	141	126	111	177	159
1925	178	161	164	196	154	172	105	162	153
1926	122	172	267	178	108	154	109	126	143
1927	128	199	190	130	122	137	101	132	121
1928	150	192	119	128	138	129	89	174	159
1929	143	179	135	135	135	117	97	162	149
1930	100	124	179	132	120	92	95	122	140
1931	61	79	104	106	77	55	82	79	117
1932	47	101	62	65	43	44	63	45	102
1933	65	124	95	68	56	66	57	57	105
1934	97	164	98	90	95	91	89	121	004
1935	94	155	71	84	119	98	89	165	126
1936	94	165	143	97	118	109	75	147	113
1937	90	191	127	105	146	122	87	140	122
1938	67	165	80	88	76	75	63	98	101
1939	70	148	98	86	73	72	58	103	109
1940	78	154	102	97	91	84	64	126	121
1941	107	254	93	108	99	95	68	162	145
1942	149	355	158	124	123	116	84	206	199
1943	160	389	214	225	158	145	107	224	245
1944	165	402	203	244	175	162	129	245	217
July	164	433	198	263	181	158	116	245	236
August	163	378	228	295	181	153	120	246	253
September	170	413	211	250	179	153	123	242	239
October	171	396	204	211	174	161	127	244	192
November	168	434	205	187	164	163	131	247	188
December	168	418	216	200	164	165	138	246	228
1945									
January	163	403	227	217	165	166	143	245	262
February	161	306	237	229	164	167	148	244	223
March	163	206	246	236	165	168	152	241	203
April	163	206	250	241	165	169	142	240	259
May	165	406	254	244	167	169	138	241	193
June	169	492	259	251	171	170	133	243	269
July	171	541	263	263	173	166	129	255	244

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Fish scrap, wet acidulated 6% ammonia, 3% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.05	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	3.54	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.25	4.59	5.16
1924	2.99	2.44	5.87	5.02	4.41	3.60	4.25
1925	3.11	2.47	5.41	5.34	4.70	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.15	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.35	4.32	5.70
1928	2.67	2.30	7.06	6.63	5.28	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.69	4.61	5.72
1930	2.47	1.81	4.78	4.96	4.15	3.79	4.58
1931	2.34	1.46	3.10	3.95	3.33	2.11	.46
1932	1.87	1.04	2.18	2.18	1.82	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.58	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.84	2.67	3.27
1935	1.47	1.15	4.59	3.10	2.65	3.06	3.65
1936	1.53	1.23	4.17	3.42	2.67	3.58	4.25
1937	1.63	1.32	4.91	4.66	3.65	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.17	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.12	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.35	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.27	3.76	4.43
1942	1.74	1.41	6.11	5.77	3.34	5.04	6.76
1943	1.75	1.42	6.30	5.77	3.34	4.86	6.62
1944	1.75	1.42	7.68	5.77	3.34	4.86	6.71
July	1.75	1.42	7.81	5.77	3.34	4.86	6.71
August	1.75	1.42	7.81	5.77	3.34	4.86	6.71
September	1.75	1.42	7.81	5.77	3.34	4.86	6.71
October	1.75	1.42	7.81	5.77	3.34	4.86	6.71
November	1.75	1.42	7.81	5.77	3.34	4.86	6.71
December	1.75	1.42	7.81	5.77	3.34	4.86	6.71
1945							
January	1.75	1.42	7.81	5.77	3.34	4.86	6.71
February	1.75	1.42	7.81	5.77	3.34	4.86	6.71
March	1.75	1.42	7.81	5.77	3.34	4.86	6.71
April	1.75	1.42	7.81	5.77	3.34	4.86	6.71
May	1.75	1.42	7.81	5.77	3.34	4.86	6.71
June	1.75	1.42	7.81	5.77	3.34	4.86	6.71
July	1.75	1.42	7.81	5.77	3.34	4.86	6.71
Index Numbers (1910-14 = 100)							
1922	113	90	173	132	117	140	142
1923	112	102	177	137	140	136	147
1924	111	86	168	142	145	107	121
1925	115	87	155	151	155	117	135
1926	113	84	126	140	146	129	139
1927	112	79	145	166	143	128	162
1928	100	81	202	188	173	146	170
1929	96	72	161	142	154	137	162
1930	92	64	137	141	136	12	130
1931	88	51	89	112	109	63	70
1932	71	36	62	62	60	36	39
1933	59	39	84	81	85	97	71
1934	59	42	127	89	93	79	93
1935	57	40	131	88	87	91	104
1936	59	43	119	97	89	106	131
1937	61	46	140	132	120	120	122
1938	63	48	105	106	104	93	100
1939	63	47	115	125	102	115	111
1940	63	48	133	124	110	99	96
1941	63	49	157	151	107	112	126
1942	65	49	175	163	110	150	192
1943	65	50	180	163	110	144	189
1944	65	50	219	163	110	144	191
July	65	50	223	163	110	144	191
August	65	50	223	163	110	144	191
September	65	50	223	163	110	144	191
October	65	50	223	163	110	144	191
November	65	50	223	163	110	144	191
December	65	50	223	163	110	144	191
1945							
January	65	50	223	163	110	144	191
February	65	50	223	163	110	144	191
March	65	50	223	163	110	144	191
April	65	50	223	163	110	144	191
May	65	50	223	163	110	144	191
June	65	50	223	163	110	144	191
July	65	50	223	163	110	144	191

Wholesale Prices of Phosphates and Potash**

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Kainit, 20% bulk, per unit, c.i.f. Atlantic and Gulf ports
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657	$0.655
1922	.566	3.12	6.90	.632	.904	23.87	....	.508
1923	.550	3.08	7.50	.588	.836	23.32	....	.474
1924	.502	2.31	6.60	.582	.860	23.72	....	.472
1925	.600	2.44	6.16	.584	.860	23.72	....	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537	.524
1927	.525	3.09	5.50	.646	.924	25.55	.586	.581
1928	.580	3.12	5.50	.669	.957	26.46	.607	.602
1929	.609	3.18	5.50	.672	.962	26.59	.610	.605
1930	.542	3.18	5.50	.681	.973	26.92	.618	.612
1931	.485	3.18	5.50	.681	.973	26.92	.618	.612
1932	.458	3.18	5.50	.681	.963	26.90	.618	.591
1933	.434	3.11	5.50	.662	.864	25.10	.601	.565
1934	.487	3.14	5.67	.486	.751	22.49	.483	.471
1935	.492	3.30	5.69	.415	.684	21.44	.444	.488
1936	.476	1.85	5.50	.464	.708	22.94	.505	.560
1937	.510	1.85	5.50	.508	.757	24.70	.556	.607
1938	.492	1.85	5.50	.523	.774	15.17	.572	.623
1939	.478	.190	5.50	.521	.751	24.52	.570	.670
1940	.516	.190	5.50	.517	.730	24.75	.573	....
1941	.547	1.94	5.64	.522	.780	25.55	.570	....
1942	.600	2.13	6.29	.522	.810	25.74	.205	....
1943	.631	2.00	5.93	.522	.786	25.35	.195	....
1944	.645	2.10	6.10	.522	.777	25.35	.195	....
July	.646	2.16	6.10	.503	.749	24.44	.188	....
August	.650	2.20	6.10	.503	.749	24.44	.188	....
September	.650	2.20	6.10	.503	.749	24.44	.188	....
October	.650	2.20	6.10	.535	.797	26.00	.200	....
November	.650	2.20	6.10	.535	.797	26.00	.200	....
December	.650	2.20	6.10	.535	.797	26.00	.200	....
1945								
January	.650	2.20	6.10	.535	.797	26.00	.200	....
February	.650	2.20	6.13	.535	.797	26.00	.200	....
March	.650	2.20	6.20	.535	.797	26.00	.200	....
April	.650	2.20	6.20	.535	.797	26.00	.200	....
May	.650	2.20	6.20	.535	.797	26.00	.200	....
June	.650	2.20	6.20	.471	.701	22.88	.176	....
July	.650	2.20	6.20	.503	.749	24.44	.188	....

Index Numbers (1910-14 = 100)

1922	106	87	141	89	95	99	....	78
1923	103	85	154	82	88	96	....	72
1924	94	64	135	82	90	98	....	72
1925	110	68	126	82	90	98	....	74
1926	112	88	114	83	90	98	82	80
1927	100	86	113	90	97	106	89	89
1928	108	86	113	94	100	109	92	92
1929	114	88	113	94	101	110	93	93
1930	101	88	113	95	102	111	94	93
1931	90	88	113	95	102	111	94	93
1932	85	88	113	95	101	111	94	90
1933	81	86	113	93	91	104	91	86
1934	91	87	110	68	79	93	74	72
1935	92	91	117	58	72	89	68	75
1936	89	51	113	65	74	95	77	85
1937	95	51	113	71	79	102	85	93
1938	92	51	113	73	81	104	87	95
1939	89	53	113	73	79	101	87	93
1940	96	53	113	72	77	102	87	....
1941	102	54	110	73	82	106	87	....
1942	112	59	129	73	85	106	84	....
1943	117	55	121	73	82	105	83	....
1944	120	58	125	73	82	105	83	....
July	121	60	125	70	79	101	82	....
August	121	61	125	70	79	101	82	....
September	121	61	125	70	79	101	82	....
October	121	61	125	75	84	108	83	....
November	121	61	125	75	84	108	83	....
December	121	61	125	75	84	108	83	....
1945								
January	121	61	125	75	84	108	83	....
February	121	61	126	75	84	108	83	....
March	121	61	127	75	84	108	83	....
April	121	61	127	75	84	108	83	....
May	121	61	127	75	84	108	83	....
June	....	....	....	66	74	95	80	....
July	....	....	....	70	79	101	82	....

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer materials‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash
1922.....	132	149	141	116	101	145	106	85
1923.....	143	152	147	114	107	144	103	79
1924.....	143	152	143	103	97	125	94	79
1925.....	156	156	151	112	100	131	109	80
1926.....	146	155	146	119	94	135	112	86
1927.....	142	153	139	116	89	150	100	94
1928.....	151	155	141	121	87	177	108	97
1929.....	149	154	139	114	79	146	114	97
1930.....	128	146	126	105	72	131	101	99
1931.....	90	126	107	83	62	83	90	99
1932.....	68	108	95	71	46	48	85	99
1933.....	72	108	96	70	45	71	81	95
1934.....	90	122	109	72	47	90	91	72
1935.....	109	125	117	70	45	97	92	63
1936.....	114	124	118	73	47	107	89	69
1937.....	122	131	126	81	50	129	95	75
1938.....	97	123	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	131	127	86	56	130	102	77
1942.....	159	152	144	93	57	161	112	77
1943.....	192	167	150	94	57	160	117	77
1944.....	195	176	151	96	57	174	120	76
June.....	193	176	151	95	57	175	119	69
July.....	192	176	152	96	57	175	121	74
August....	193	176	151	96	57	175	121	74
September.	192	176	151	96	57	175	121	74
October...	194	176	152	97	57	175	121	78
November.	196	177	152	97	57	175	121	78
December..	200	178	152	97	57	175	121	78
1945								
January...	201	179	153	97	57	175	121	78
February..	199	179	153	97	57	175	121	78
March....	198	180	153	97	57	175	121	78
April.....	203	180	154	97	57	175	121	78
May.....	200	180	154	97	57	175	121	78
June.....	206	180	155	95	57	175	121	69
July.....	206	180	154	96	57	175	121	74

* U. S. D. A. figures.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning with June 1941, manure salts prices are F. O. B. mines, the only basis now quoted.

**** The annual average of potash prices is higher than the weighted average of prices actually paid because since 1926 better than 90% of the potash used in agriculture has been contracted for during the discount period. From 1937 on, the maximum seasonal discount has been 12%.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizer

"Commercial Fertilizers and Agricultural Minerals 1944," Bu. of Chemistry, Dept. of Agr., Sacramento, Calif., Sp. Publ. 208.

"Commercial Fertilizers Report for 1944," Agr. Exp. Sta., New Haven, Conn., Bul. 483, Nov. 1944, E. M. Bailey.

"State Laboratory—Fertilizer, Seed, Lime and Ice Cream Report, July-December 1944," State Board of Agr., Dover, Del.

"Commercial Fertilizers in Kentucky in 1944," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Reg. Ser. Bul. 42, June 1945, J. D. Turner, H. R. Allen, and Lelah Gault.

"Fertilizing Burley Tobacco," Agr. Ext. Div., Univ. of Ky., Lexington, Ky., Leaf. 63, Jan. 1944, P. E. Karraker, R. A. Hunt, and E. J. Kinney.

"Commercial Fertilizers," N. M. Feed & Fert. Control Office, State College, N. M., 15th A. R., R. W. Ludwick and L. T. Elliott.

"Fertility Runoff Losses from Manure Spread During the Winter," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 523, May 1945, A. R. Midgley and D. E. Dunklee.

"100,000 Tons of Hay," Agr. Ext. Serv., State College of Wash., Pullman, Wash., E. Bul. 324, April 1945, Karl Baur and I. M. Ingham.

"Fertilizer Tonnage Sales Survey Report for Washington for July 1, 1943 to June 30, 1944," Agr. Exp. Sta., State College of Wash., Pullman, Wash., M. Cir. 26, May 1945, S. C. Vandecaveye.

"How Much Fertilizer Shall I Use?" U.S. D.A., Washington, D. C. AIS-18, April 1945, Charles E. Kellogg.

Soils

"Soil Survey of the Woodstock Area," New Brunswick Dept. of Agr., Dom. of Canada, Ottawa, Can., Publ. 757, T. B. 48, March 1944, P. C. Stobbe and H. Aalund.

"Land Types in Eastern Colorado," Agr. Exp. Sta., Colo. State College, Fort Collins, Colo., Bul. 486, June 1944, L. A. Brown, D. S. Romine, R. T. Burdick, and Alvin Kezer.

"Toledo Soil Experiment Field 1913-1944," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Ag. 1023, April 1945, F. C. Bauer and P. E. Johnson.

"Recent Findings and Recommendations in Soil Management by the Soils Section, Dept. of Agronomy," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., A-Mim. 142, May 1945.

"The Exchangeable Bases of Two Missouri Soils in Relation to Composition of Four Pasture Species," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., R. Bul. 385, Nov. 1944, C. E. Marshall.

"Subsoil Water Investigations at the Huntley Branch Station," Agr. Exp. Sta., Mont. State College, Bozeman 2, Mont., Bul. 428 (T), Feb. 1945, S. H. Hastings and D. Hansen.

"A Soil Improvement Program for Oklahoma," Ext. Serv., Okla. A. & M. College, Stillwater, Okla., Cir. 412, Wesley Chaffin.

"Washington Irrigation Series; Soil, Plant, and Moisture Relationships," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Bul. 321, Feb. 1945, C. F. Webster and R. N. Miller.

"Investigations in Erosion Control and Reclamation of Eroded Shelby and Related Soils at the Conservation Experiment Station, Bethany, Mo., 1930-42," U.S.D.A., Washington, D. C. T. Bul. 883, April 1945, D. D. Smith, D. M. Whitt, A. W. Zingg, A. G. McCall, and F. G. Bell.

Crops

"The Shasta, Sierra, Lassen, Tahoe, and Donner Strawberries," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif. Bul. 690, Feb. 1945, H. E. Thomas and E. V. Goldsmith.

"Twenty-fifth Annual Report," Dept. of Agr. State of Calif., Sacramento, Calif.

"Pasture for Poultry," Central Exp. Farm, Ottawa, Canada, Publ. 771, F. B. 128, May 1945, H. S. Gutteridge and F. S. Nowosad.

"Fifty-seventh Annual Report 1943-44," Colo. Agr. Exp. Sta., Colo. State College, Fort Collins, Colo.

"Ladino Clover," Ext. Serv., Univ. of Conn., Storrs, Conn., E. Fold. 2, May 1945, J. S. Owens.

"Annual Report of the Director, June 30, 1944," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. 251, Dec. 1944.

"1944 Report Florida Agricultural Extension Service," Univ. of Fla., Gainesville, Fla.

"Strawberry Production," Agr. Ext. Serv., Gainesville, Fla., Bul. 125, March 1945, A. N. Brooks.

"Bromegrass in Iowa," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Bul. P75, June 1945, C. P. Wilsie, M. L. Peterson, and H. D. Hughes.

"Nicotine Content of Nicotiana Rustica Grown in Kentucky and of 15 Selections of Dark Tobacco," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 470, Nov. 1944, C. W. Woodmansee, K. E. Rapp, and J. S. McHargue.

"The Beach Plum in Massachusetts," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Bul. 422, Dec. 1944, J. S. Bailey.

"The Culture of Set Onions in the Connecticut Valley," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Bul. 424, April 1945, W. G. Colby, C. J. Gilgut, and H. M. Yegian.

"Tomato Diseases in Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Cir. Bul. 139 (Second Revision), Jan. 1945, M. C. Strong.

"Asparagus Production in Michigan," Agr. Exp. Sta., Mich. State College, East Lansing, Mich., Cir. Bul. 194, Jan. 1945, S. B. Apple and K. C. Barrons.

"Corn Production and Improvement," Ext. Serv., Miss. State College, State College, Miss., Cir. 127-(25M), May 1944, J. M. Weeks.

"Young Orchards; Planning, Planting, and Management," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Cir. 299, March 1945, T. J. Talbert.

"Flaxseed Production in Montana," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 429, April 1945, A. H. Post and S. C. Litzenberger.

"Varieties of Oats for Nebraska," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Bul. 375, Feb. 1945, K. S. Quisenberry, O. J. Webster, and T. A. Kiesselbach.

"Standards for Judging the Growth Status of Apples in New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 715, March 1945, M. A. Blake, L. J. Edgerton, and O. W. Davidson.

"Growing Alfalfa in New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 718, May 1945, G. H. Ahlgren, H. B. Sprague, and F. E. Bear.

"Propagating Blueberries from Hardwood Cuttings," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 490, March 1945, C. A. Doehlert.

"Improved Pastures from Better Grasses and Legumes," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 492, May 1945, H. R. Cox and G. H. Ahlgren.

"Growing Holly," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 493, May 1945, C. H. Connors.

"Annual Report 1944," Agr. Ext. Serv., State College Sta., Raleigh, N. C.

"Some Factors Affecting Production of Market or Garden Peas," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 354, March 1945, W. C. Barnes and C. N. Clayton.

"Agricultural Research in South Dakota," Agr. Exp. Sta., S. Dak. State College of A. & M., Brookings, S. Dak., 57th A. R.

"Rancher Sorghum a Low Hydrocyanic Acid Forage," Agr. Exp. Sta., S. Dak. State College, Brookings, S. Dak., Cir. 57, Feb. 1945, C. J. Franzke.

"Ree Wheatgrass, Its Culture and Use," Agr. Exp. Sta., S. Dak. State College, Brookings, S. Dak., Cir. 58, Feb. 1945, C. J. Franzke.

"Buckwheat—Crimson Clover for Grain and Pasture," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Leaf. 78, May 1945, H. E. Hendricks.

"Sweet Potato Production in Tennessee," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 287, March 1945, Arthur Meyer.

"Pasture Development in the East Texas Timber Country," Agr. Exp. Sta., A. & M. College, College Station, Texas, Bul. 666, Jan. 1945, E. K. Crouch and J. H. Jones.

"Kudzu in Texas," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 927, Jan. 30, 1945, E. B. Reynolds.

"Grain Sorghums Under Irrigation in the Wichita Valley," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 936, March 5, 1945, L. E. Brooks.

"Second Report of the Vt. State Soil Conservation Committee," Burlington, Vt., Nov. 1944.

"Strawberry Growing in Washington," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Bul. 246 (Rev.), April 1945, J. C. Snyder.

"Growing Raspberries & Blackberries in Wisconsin," Ext. Serv., Univ. of Wis., Madison, Wis., Stencil Cir. 240, Feb. 1945, J. G. Moore.

"Barley in Wisconsin for 1945," Ext. Serv., Univ. of Wis., Madison, Wis., Sp. Cir., Feb. 1945, B. D. Leith and H. L. Shands.

"Measuring Productive Capacity of Pastures through Maintenance Studies with Mature Steers," U.S.D.A., Washington, D. C., T. Bul. 890, April 1945, A. O. Rhoad and R. B. Carr.

"Soybeans: Certain Agronomic, Physical, Chemical, Economic, and Industrial Aspects," U.S.D.A., Washington, D. C., AIC-74, May 1945, J. H. Shollenberger and W. H. Goss.

Economics

"Thirty-five Years of Farm Prices to Idaho Farmers," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 260, April 1945, A. N. Nybroten.

"Indiana Crops and Livestock," Dept. of Agr. Statistics, West Lafayette, Ind., No. 231, Dec. 1944.

"The Negro Farm Family Moves Ahead," Ext. Serv., Univ. of N. C., Raleigh, N. C., Cir. 281, April 1945.

"Selecting a Farm in North Carolina," Agr. Ext. Serv., Univ. of N. C., Raleigh, N. C., Cir. 283, June 1945, R. E. L. Greene, H. Brooks James, and R. W. Shoffner.

"North Carolina Agricultural Statistics," N. C. Crop Reporting Serv., Raleigh, N. C., No. 86, 1944 Annual Issue.

"Farm Aid for Veterans," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Leaf. 77, Feb. 1945, F. J. Walrath.

"Changes in Tennessee Agriculture," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Publ. 288, June 18, 1945, J. H. McLeod.

"Wartime Farm Land Market Activity in Three Farming Areas of Texas, 1941-1944," Agr. Exp. Sta., A. & M. College, College Station, Texas, P. R. 942, March 1, 1945.

"Wartime Land Market Activity in the State of Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., V Cir. 21, Dec. 1944, H. V. Stonecipher, Dora Dunn, and C. N. Berryman.

"Suggestions to Prospective Yakima County Settlers," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Bul. 326, March 1945.

"Maximum Wartime Production Capacity of Agriculture State of Washington for 1945," Agr. Exp. Sta., Pullman, Wash., A. E. 4, July 1944.

"The Influence of Specialization and Diversification on Farm Organization, Types of Farming, and Agricultural Production in Washington," Agr. Exp. Sta., State College of Wash., Pullman, Wash., A. E. 6, March 1945, M. T. Buchanan.

"Report of the Combined Food Board," U.S.D.A., Washington, D. C., April 1945.

"If You're Thinking of a Little Place in the Country," U.S.D.A., Washington, D. C., AIS-14, 1945, A. B. Genung.

"Farmers Look at Post-war Prospects," U.S.D.A., Washington, D. C., AIS-20, May 1945.

"What Peace Can Mean to American Farmers," U.S.D.A., Washington, D. C., M. P. 562, May 1945.

"Usual Dates of Planting and Harvesting Commercial Truck Crops for Fresh Market," U.S.D.A., Washington, D. C., BAE, July 1945, C. O. Parker and R. Royston.

"Fruits (13 Noncitrus) Production and Utilization 1934-44," U.S.D.A., Washington, D. C., BAE, C. D. Palmer, E. O. Schlotzhauer, P. E. Kiesler, and R. Royston.

"Farm Production, Farm Disposition, and Value of Principal Crops, 1943-44," U.S.D.A., Washington, D. C., May 1945.

"List of Available Publications," U.S.D.A., Washington, D. C., M. P. 60 (Rev. Jan. 1945).

"Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Stations 1944-45," U.S.D.A., Washington, D. C., M. P. 556, May 1945, B. T. Richardson.

Trace "Tagged" Atoms

"Tagging" atoms by using the cyclotron machine to make the atoms radioactive is one of the newer tools of plant research. By tracing an irradiated or "tagged" chemical as it moves within the plant, scientists of the U. S. Department of Agriculture and the Ohio Agricultural Experiment Station think they will be able to explain some fundamental questions not answered yet. They hope for explanation of such puzzles as the formation and action of chlorophyll —the green coloring matter of plants— and how starch is formed from the carbon dioxide the plant draws from the air and water from the soil, and how and where starch changes to sugar.

With the cyclotron machine, Dr. J. D. Sayre of the Agricultural Research Administration explains, it is possible to make many chemicals temporarily radioactive in much the same way that radium is radioactive. A delicate laboratory tool, the Geiger Counter, is so sensitive to radiations that it registers the presence of a single charged atom. This combination permits the tracing of tagged atoms as they move within a plant. Fortunately, even after irradiation, atoms still combine chemically in the same way that normal atoms do.

Thus, if a scientist uses an irradiated chemical—phosphorus, for example—in a solution around the roots of a plant, he can use the "counter" to measure the number of irradiated phosphorus atoms passing up the stem of the plant. By extending such studies of tagged atoms it should be possible to find out where in the stem—or leaves or fruit—of a plant the phosphorus ceases to move. This would point out an area worth study to discover whether the phosphorus had entered into a new chemical combination—and the nature of the new combination. A man wise in plant chemistry might then be able to answer some baffling questions.

Research of this type calls for almost unlimited skill, precision and patience —often for teaming of several specialists; for knowledge and imagination in interpreting results. Full answers to the big questions may lie far in the future. Meantime, experience with other basic research shows that partial

answers may solve practical problems and make such work highly profitable. The Research Administration points out that scientists know they are still only on the threshold of studies of growth regulating substances or hormones, but the practical gains from hormone sprays (used to prevent the drop of apples before they are ripe) far exceed the cost of all the hormone research; and already there are several other byproducts in the rooting of nursery cuttings, in weed eradication, in production of unfertilized and seedless fruit, and in other fields of plant development.

Soil Treatment Increases Ratio Of Corn to Cob

Corncobs were found to make up a smaller portion of the corn yield on land having a good system of soil treatment than on untreated land in official tests conducted by the Illinois Agricultural Experiment Station and reported by H. J. Snider, assistant chief, soil experiment fields, University of Illinois College of Agriculture.

Corn from untreated land on the Ewing Experiment Field contained 23 per cent cobs, while the same hybrid, in the same season, contained only 15 per cent cobs on land treated with crop residues, limestone, rock phosphate and potash.

"On this basis, 1,000 bushels of ear corn from untreated land would contain 560 pounds more worthless material than the same amount of corn from well-treated land. The feeder who feeds this type of corn must handle this amount of extra worthless material, and the man who buys such corn must pay for 560 extra pounds of cobs which are of no value to him.

"This loss to corn growers and feeders is in addition to the lower yields received by farmers who fail to look after the fertility of their land," Snider said.

Cover Crops Conserve

Keep fall gardens planted. Keep them fertilized. And don't waste fertilizer.

This trio of suggestions to Victory Gardeners may cause some vegetable growers to make changes in their usual fall routine. They also put an extra premium on cover crops in gardens this year, says Victory Garden Headquarters at the U. S. Department of Agriculture.

In urging late planting of crops to get out of the garden every last bit of food for the table and for canning, freezing and storing, vegetable specialists emphasize the importance of adding fertilizer to keep the crops well nourished and growing thriftily in the cooler fall days. To supply enough fertilizer for best results with fall crops means that there is bound to be some fertilizer unused when the crops stop growing. Cover crop plants capture this plant food and prevent it from leaching away in winter rains. This fact makes it especially important this year to plan for cover crops in the garden to salvage this plant food and conserve it for use in the early spring when the cover crop is turned under.

This is only one advantage of a cover crop in the garden. Two other advantages are: (1) addition of valuable humus that all soils need, and vegetable gardens particularly need; and (2) protection of the garden plot from erosion and loss of soil in winter rains.

Cover crops vary with local conditions, and inexperienced gardeners are advised to get information from garden leaders or agricultural extension agents

as to what and when to plant. Winter wheat and rye are good cover crops over wide areas. Legume crops have the added value of gathering nitrogen from the air for conversion into plant food when the crops decay after they are turned under. In many gardens it is practical to plant cover crops between the rows several weeks before the final harvest of the vegetables.

From Scrub Pine to Broccoli on Cape Cod

(*From page* 20)

vened, sending him to the hospital for injuries received on the race track. It was while recuperating at his home that he became acquainted with Peter Levanti, a well-known and successful market gardener of West Newton, Massachusetts. Apparently Mr. Levanti saw that Bill was a good prospect for gardening, for they made a deal to go into farming in a big way on a 200-acre tract of land located at Portsmouth, Rhode Island. That was in 1933. A year later, Bill took over the project as his own responsibility and conducted his vegetable growing business there until December 31, 1941, when the lease expired.

That brings him up to date except to say that you should also know the other partner of this enterprise, Mrs. William Richards. She is not a farm-raised girl either. Her home was in Chicago and at that time farming was a business that received little or no thought, other than that given when making purchases of food. Now, she is a real enthusiast and partner in the vegetable growing business at Veg-Acre Farms,—and, oh yes, they have a fine family of youngsters, consisting of three girls, Roberta, Wila and Jean and last but by no means least, the youngest, a son, William, Jr.

Potash Fertilizers Are Needed on Many Midwestern Farms

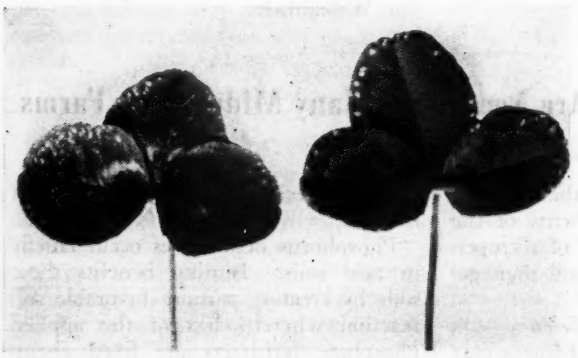
(*From page* 16)

trogen fertilizers to bring the nitrogen supply up to the requirements of the corn crop. This "banner" of nitrogen deficiency implies a poor soil management program in progress.

Leaf 3—*Phosphorus Deficiency*—On young plants purplish-tinted leaves may mean a deficiency of phosphorus. This plant nutrient is required for cell-division and growth of the plants. When deficient, plants make slow progress in growth and development. The stalks are spindly and stunted. The leaves on such plants may appear healthy if adequate nitrogen and potash are available to them, yet their slow growth is significant. Frequently the silks are too slow in emerging from the ears and are imperfectly pollinated. Ears that are ultimately produced on such plants are characterized by defective rows of kernels.

Phosphorus deficiencies occur chiefly in acid soils. Liming benefits these soils by creating a more favorable soil reaction whereby less of the applied phosphate fertilizers are fixed chemically in these soils. Well-fertilized legumes in the rotation will increase the phosphate supply contained in the organic matter when they are plowed under for the corn crop. Phosphates are well protected from the soil fixation processes when held in organic matter, and subsequent crops are thereby benefited.

Leaf 4—*Potash Deficiency*—Yellow and brown, "scorched" edges of the leaves indicate a deficiency of potash available to the plants. This symptom



Figs. 6 & 7. Above, Alfalfa; below, Red and Alsike clover. Potash deficiency is indicated by white spots on these legumes. Later, edges of leaves become dry and appear scorched.

must be distinguished from the yellowing of the midribs which characterizes nitrogen starvation. Potassium is the mineral nutrient that determines the efficient working of the corn plants. It is needed in all parts of the plant for growth, for starch production, for the manufacture of proteins, for the translocation of plant foods, and for the absorption of mineral nutrients by the roots. It is the health-governing element in plants that gives them resistance to certain diseases. It enables the plants to protect themselves better against low temperatures.

To best describe the symptom of leaf "scorch," potassium in its role in plants can be likened to the use of oil in gas engines. If the supply of oil is inadequate, the bearings burn out and the cylinders "scorch." In plants starved for potash the leaf tissues "burn out." The areas of green tissues are reduced and the plants suffer accordingly from inadequate machinery to produce sugars and starches for normal growth and production.

Fig. 3 shows a corn plant when the supply of potash was insufficient to maintain healthy foliage. Note the shortened stalk and spindly, damaged leaves. The joint tissues inside the plant also were badly damaged.

Fig. 4 shows a close-up of one of these plants. Note the yellow-streaked and marginal-scorched leaves. Fig. 2 shows the effect of a potash deficiency when the plants were fertilized with nitrogen and phosphate fertilizers only. Under such circumstances the roots of the plants become rotted and severe lodging occurs. Ears from potash-starved plants are shown in Fig. 5.

When potash starvation symptoms are noticed on corn plants, a definite degree of soil exhaustion is indicated. The only way to correct this deficiency is to either let the land revert back to the Indians or to apply potash fertilizers.

In the first case the naturally slow liberation of potassium may occur and after a number of years the land may again come into production.

No specific recommendations can be made for using potash fertilizers on any crop in all soils. Tests of soil samples made at the agricultural experiment stations are helpful because the information from the experimental fertility fields in each state serves as a background against which fertilizer recommendations are made. Trials with potash fertilizers on individual farms should be made, and sufficient quantities to correct the deficiencies should be applied. Remember that when symptoms of deficiencies are found, *serious* shortages are present. It is far better to use potash fertilizers in amounts sufficient to maintain the health of crops than to wait until starvation conditions develop.

Potash-deficiency symptoms differ on various legumes. The early symptoms displayed by alfalfa and clovers are shown in Figs. 6 and 7. Note the white spots on the leaves. Later the edges of the leaves become dry and the general appearance of "edge scorch" is found. Usually these symptoms are most pronounced after the first cutting of hay. Where they have been found, top-dressings of potash fertilizers have proven helpful in preventing the "running out" of alfalfa.

With soybeans, Fig. 8, the symptom of approaching potash starvation is shown by a yellowing of the leaf tissue around the edges of the leaf and between the veins. Later the leaves become "edged-scorched" and brown spots are found in the intervenal tissues. Such evidence of potash deficiency points to the need for higher amounts of potash fertilizers to be applied to all of the

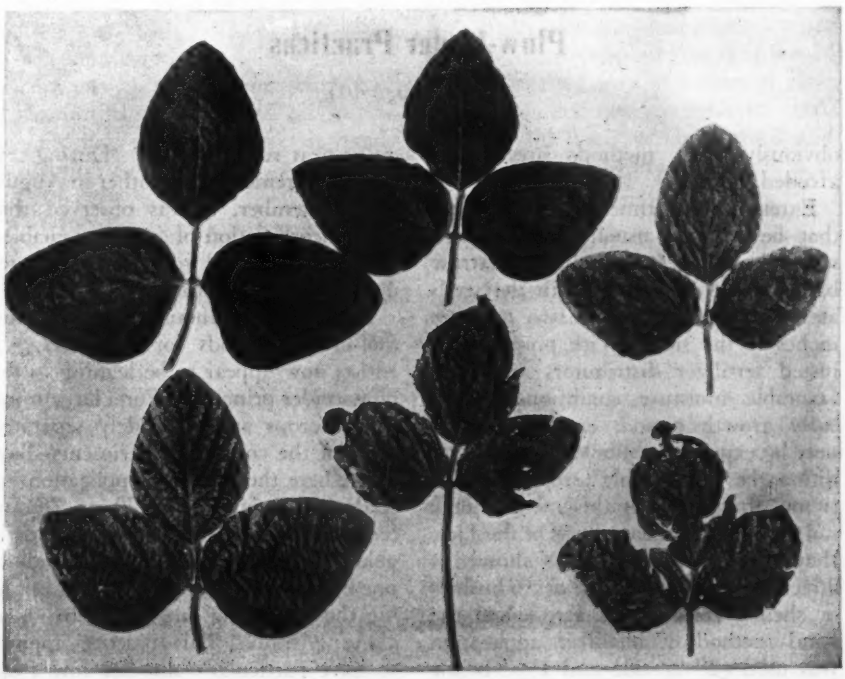


Fig. 8. The foliage of soybean plants deteriorates rapidly when the supply of available potash becomes deficient during the growing season. The leaves first turn yellowish green and become crinkled.

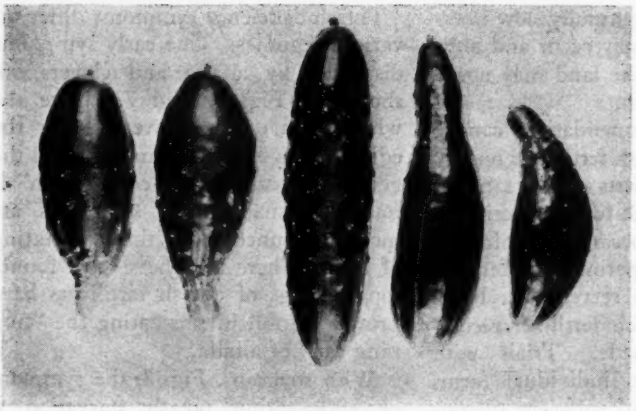


Fig. 9. Left, "pickles" tapering toward the end indicate nitrogen starvation. Right, tapering toward the stem end indicates potash starvation.

symptoms on any crops must be given serious consideration in plans for soil fertility maintenance. They indicate a neglect that can be remedied only by the direct use of potash fertilizers or by a greatly increased return of manure or crop residue rich in potash to the soil. Successful farming requires close co-operation with Nature in producing crops. The official interpreters of Nature's requirements for producing crops are the agricultural advisory forces.

crops in the rotation. It is too late to use potash as a top-dresser on soybeans after the symptoms appear.

The appearance of potash-deficiency

Plow-Under Practices

(*From page* 10)

obviously such methods are to be avoided.

Extensive experiments have shown that best results usually are obtained when the fertilizer is applied in narrow bands about on a level with the seeds at time of planting and two to three inches to the side. With properly adjusted fertilizer distributors and with favorable moisture conditions during early growth period, excellent results may be expected. Should moisure conditions be unfavorable resulting in extreme drought, even this method may fail to work satisfactorily. On the Hershey Farms, 1936-1937-1938 showed a three-year average increase of 9.6 bushels of shelled corn to the acre when the band method of fertilizer application was used (2″ at side and 1½″ below seed level) over the conventional corn planter method which placed fertilizer on or near surface of soil. During seasons of extremely dry weather in August and September, it was observed that deep incorporation of fertilizer enabled corn to withstand to a much greater degree droughty weather conditions.

In their continuous efforts to find fool-proof methods for fertilizers, scientists now appear to be leaning to the plow-under principle. For a large number of crops and in widely separated areas of the country, experiments show that where the fertilizer application exceeds 800 pounds of a 20- to 30-unit fertilizer per acre, it is frequently advisable and profitable to plow under about one-half of the total application, applying the remaining one-half in bands at planting time. This practice appears to have particular value for row crops which because of need for rather liberal fertilization might be injured if the

This alfalfa field received an annual application of 400 lbs. of 0-14-20 fertilizer per acre.

entire amount were applied in bands and dry weather should come shortly after planting. As a proof of this contention, tests with potatoes 1942-1943-1944 gave a three-year average increase of 34.5 bushels to the acre when half of the fertilizer was placed on furrow sole and half with the planter in bands at planting time.

Were Pliny and Cato writing in this day, with the background of modern farming equipment now available in contrast to what they had to work with, there is little doubt but that they would stress efficiency in application of both organic matter and commercial fertilizer, as the basis of any sound and permanent soil fertility program.

Fertilizing for Better Soybeans in North Carolina

(*From page* 26)

per cent. The response of soybeans to applications of limestone as related to the soil characteristics is not entirely clear in North Carolina. Experiments have been initiated to aid in clarifying the relationship.

Five exploratory experiments were conducted to obtain information on the probable need of minor element additions for soybeans. Base treatments of the major elements were made. It will be noted in Table 4 that in two of the soils omitting the complete mixture of minor elements significantly reduced yields. On Norfolk sandy loam (after corn) the greatest part of this decrease was due to lack of boron. Omitting the boron from the complete mixture on the Portsmouth sandy loam decreased yields 6.7 bushels. On the other three soils omitting copper gave the greatest part of the decrease.

Ten pounds of zinc sulfate did not affect yields. Twenty-five pounds, however, significantly reduced yields at two locations. Basic slag increased the yield

on one soil. The effect of omitting molybdenum and cobalt was not determined in these experiments. In another experiment not reported here, however, these elements were omitted from a complete minor element mixture without effect.

Potash and magnesium differentials were also included in these experiments (Table 4). A 3.3-bushel increase from 60 pounds of K_2O was obtained on Norfolk soil (after tobacco). A 8.3-bushel response was obtained on Norfolk sandy loam (after soybeans). There were severe potash-deficiency symptoms on the no-potash plots in the experiments. These two soils contained .06 and .04 m.e. of exchangeable potash, respectively. On the basis of soil analyses a response to potash would also be expected on the Lenoir sandy loam.

Magnesium gave an increase in yield of 7.6 bushels on the Portsmouth sandy loam. Why this increase should occur on this soil containing .62 m.e. of magnesium is not clear. On the Norfolk sandy loam (after soybeans) marked magnesium-deficiency symptoms appeared on the soybeans on the no-magnesium plots at the beginning of rapid pod development. The increase in yield from magnesium was only 2.4 bushels, however. This soil contained .17 m.e. of exchangeable magnesium.

The highest yield in any of these five experiments was 22.1 bushels per acre. This would indicate that there were factors other than deficiencies of potash, magnesium, or minor elements operating to limit soybean yields.

Certain of the dark-colored soils of the lower Coastal Plain are very sensitive to overliming and increasing the reaction to pH 5.8 or 6.0 may cause severe manganese deficiency. Manganese-deficient areas on the sites of previous lime piles are numerous in the soybean growing area.

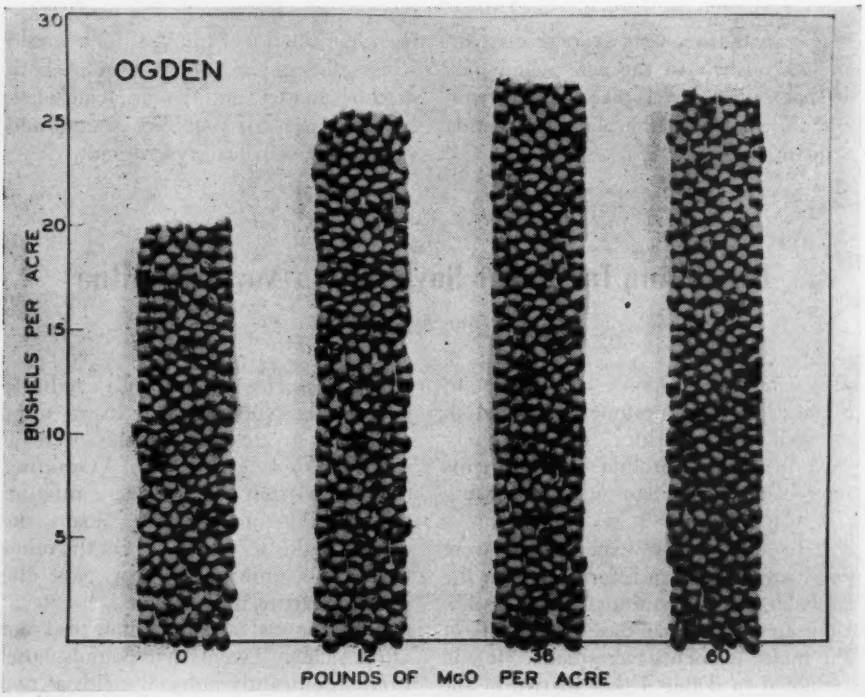


Fig. 3. Magnesium also increased the yields of Ogden soybeans on Coxville very fine sandy loam.

TABLE 4.—EFFECT OF MINOR ELEMENTS, POTASH, AND MAGNESIUM ON YIELDS OF SOYBEANS AT FIVE LOCATIONS (BU/A).

Treatments	Norfolk sandy loam-Jones Co. (after corn) Tokio	Norfolk sandy loam-Jones Co. (after tobacco) Tokio	Norfolk sandy loam-Jones Co. (after soybeans) Arksoy	Lenoir sandy loam-Jones Co. (after corn) Woods Yellow	Portsmouth sandy loam-Beaufort Co. (aft. pot.) Herman
K_2O–MgO–S	15.7	18.4	20.4	21.6	18.7
K_2O–MgO	7.4	16.0	18.2	19.4	16.0
K_2O–MgO–(S with 25 # $ZnSO_4$)	13.2	16.9	15.8	21.1	14.7
K_2O–MgO–(S minus Zn)	15.6	19.0	18.9	21.0	15.6
K_2O–MgO–(S minus Cu)	14.3	15.4	17.0	19.7	15.8
K_2O–MgO–(S minus B)	11.3	18.2	18.0	22.1	12.0
K_2O–MgO–Basic slag 400#/A	11.5	19.5	19.8	19.6	16.8
–MgO–S	15.4	15.1	12.1	20.3	16.7
K_2O– –S	13.7	17.8	18.0	20.7	11.1
No fertilizer	9.4	15.4	15.9	17.5	16.4
L. S. D. (.05)	6.4	3.5	3.8	2.2	3.6
Soil analyses					
pH	4.5	4.8	4.6	5.2	4.8
Base exchange capacity m. e.	3.65	3.87	2.95	3.77	13.3
Ca (m. e.)	.65	.72	.68	.78	3.79
Mg (m. e.)	.27	.20	.17	.21	.62
K (m. e.)	.08	.06	.04	.05	.21
P_2O_5 (lbs./A)	86.0	72.0	257.0	tr.	450.0
O. M. (%)	1.2	1.4	.8	1.3	4.5

* K_2O (60 lbs./A) from muriate of potash MgO (36 lbs./A) from magnesium sulfate.
"S" is a mixture of minor elements as follows: Zinc sulfate 10 lbs./A, borax 5 lbs./A, manganese sulfate 25 lbs./A, copper sulfate 50 lbs./A, sodium molybdate 1 lb./A, and cobalt chloride 2 lbs./A.

All treatments side-dressed before the first cultivation.

Summary

Thus far potash has been found to be the principal nutrient limiting soybean yields in North Carolina. This need can in part be detected by soil analyses. If the deficiency is acute, the symptoms will appear on the leaves. In the 1944 experiments there was no indication that lack of potash caused the leaves to remain green until frost as reported by Snider.[3]

Magnesium is limiting on some soils. In general, those soils containing less than .17 m.e. of exchangeable magnesium will require an additional supply.

The identification of the environmental factors which produced a yield of 43.0 bushels on the Portsmouth sandy loam would aid in solving some of the production problems with soybeans. The environmental factors in this soil were such as to utilize the native soil potash to give a yield of 31 bushels and then utilize additional potash to raise the yield to 43.0 bushels. This soil had a pH of 4.6 but had 3.64 m.e. of exchangeable calcium.

The fertilizer recommendations based

[3] Snider, H. J. Potassium—A Key Element. Better Crops With Plant Food. March 1945.

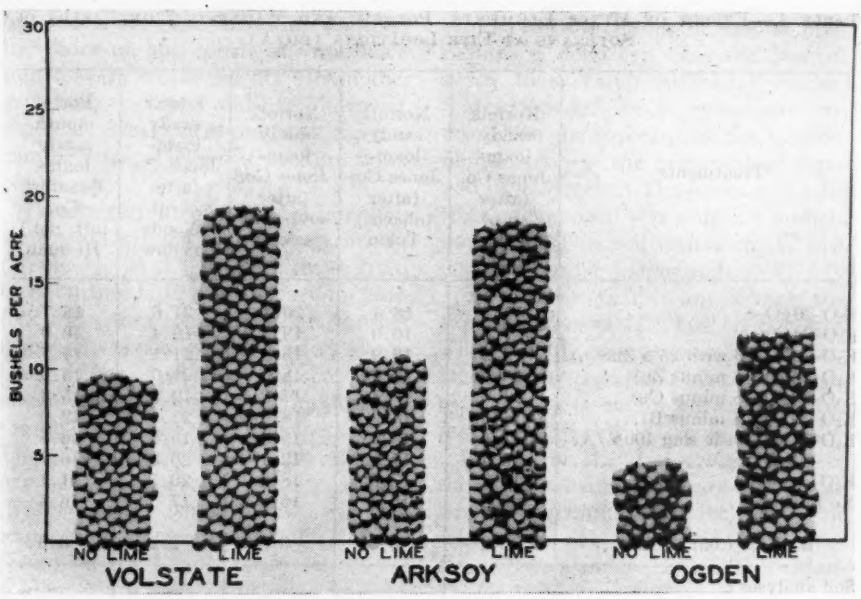


Fig. 4. Lime increased the yield of three varieties of soybeans grown on Norfolk loamy sand (Wilson County).

on the information up to the present are: first, to broadcast dolomitic limestone in accordance with soil requirements; and second, to side-dress 75 to 100 pounds of muriate of potash before the first cultivation. Under very high yielding conditions more potash may be profitable as a 40-bushel crop of soybeans removes approximately 50 pounds of K_2O. On soils which have received very low amounts of fertilizer in the past a pre-planting application of 200-300 pounds of 0-12-12 per acre should be made.

Effect of Borax and Lime on Quality of Cauliflowers

(*From page* 11)

applied with the lime, only a small percentage of the plants showed symptoms of boron deficiency and practically all of the plants were normal.

The soil on which the test was conducted had received previous applications of lime, its reaction being about neutral; and the lime applications undoubtedly overlimed the soil, causing a reduction in the amount of available boron. Thus, the lime applied alone damaged the quality of the cauliflowers. However, in every case an application of 20 pounds of borax with the lime corrected the injurious effect of overliming.

Many soils in the truck-crop area of Mississippi have been overlimed, and in many cases the cauliflower crop has been injured by a deficiency of boron. Such damage to the cauliflower crop has cost the growers thousands of dollars. Where the soil has been overlimed, small applications of borax

should be applied to correct the injurious effect of overliming, and even on soils which have not been overlimed, a small application of borax is cheap insurance in order to protect the quality of cauliflowers.

EFFECT OF BORAX AND LIME UPON THE QUALITY OF CAULIFLOWERS
Crystal Springs Truck Crops Branch Station, 1942

Borax	Lime treatment[1]	Extent of damage to plants caused by boron deficiency					Index showing[2] relative percent of normal plants
		No damage, normal plants	Slightly damaged, 80% normal	Moderately damaged, 60% normal	Badly damaged, 40% normal	Severely damaged, 20% normal	
Rate per acre		Number o plants in each class					
No borax	No lime	44	14	15	12	18	78.8
20 lbs. borax	No lime	78	5	2	1	0	97.0
40 lbs. borax[3]	No lime	51	2	0	0	0	99.3
No borax	4,000 lbs. lime	21	9	20	26	29	62.2
20 lbs. borax	4,000 lbs. lime	67	4	0	0	0	98.6
No borax	1,500 lbs. lime	23	11	11	11	13	63.7
20 lbs. borax	1,500 lbs. lime	85	8	1	0	0	97.8

[1] All plots received 1,000 pounds of 4–8–4 fertilizer per acre. Each treatment was replicated 4 times.
[2] Index derived by multiplying number of normal plants by 100, number slightly damaged by 80, number moderately damaged by 60, number badly damaged by 40, and number severely damaged by 20, and then dividing the sum by the total number of plants in each group.
[3] Most plants showed injury from boron toxicity.

Red Clover Suggests Shortage of Potash

(*From page* 21)

provides nitrogen and potassium in liberal amounts. Since clover as a legume does not suffer nitrogen shortage, the benefits by manure suggest that it is the provision of the potassium that is largely responsible for the good effects of manure on red clover. They suggest that potassium as a fertilizer may be a means of bringing back the red clover that is playing less and less a part in our cropping program of growing good forage feeds.

On Sanborn Field trials are now under way to test the wider use of potassium as a fertilizer to correct what seems the next great deficiency for clover after those of calcium and phosphorus have been met. The changes in plans at the close of 50 years of crops on the field permitted the introduction of potassium, along with the lime, phosphate, and manure treatments. Nurse-crop competition, that was removed in this case of wheat with the clover by cutting the border to result in much better clover there than in the stubble, points forcefully to potassium deficiency. Wheat straw requires 18 pounds of potassium per ton. Straw removal during the past 55 years of cropping of this plot has depleted the potash to such a degree that now the soil can give this nutrient sufficiently for clover only when the competing nurse crop is taken out. If the nurse crop and the red clover are both to be a success, more fertility must be added. Here where lime has been applied and manure that adds so little phosphorus is so beneficial, we must look to the suggestion that potassium is the deficiency holding down the red clover crop.

When competition for the soil fertility between the nurse crop and the legume crop is so keen as to kill out the legume, then we must either seed the crops separately in succeeding years or must supply the extra soil fertility needed to finish the nurse crop and carry forward the accompanying legume crop. It would seem economy to do the latter when a few hundred pounds of fertilizer is the only cost involved. It is only when we look to the mineral fertility that we can use the legumes to provide for us the nitrogen fertility from the free air.

Such demonstrations by the red clover itself suggest that very probably this valuable crop is moving toward its final extinction on the very soils where it once grew. This extinction is coming on simply because the soil has not been given the essential kind of fertility, or a sufficient form of such soil nourishment for the clover crop's survival after the nurse crop has drawn on it. Red clover on Sanborn Field is suggesting that this desirable legume cannot be a soil-builder in terms of taking nitrogen from the air unless it is given some attention by way of fertility treatments that include not only lime and phosphate but potassium as well.

Science Speaking

(*From page* 5)

search and who are apt to make direct use of it sooner or later to have access to the best official news and backgrounds fresh from the grist mill. Yet he touched on a couple of points, incidentally, that bear repeating.

"We must avoid over-dramatized presentations of research data which may raise false hopes," he stated. That goes for me too, as I have seen many a ripe research report ballyhooed and buncoed by flash writers seeking only the fleeting impressionistic viewpoints. Going further in this thought, he said he did not favor use by our learned doctorate of "weasel words" when describing the limitations and modifications involved in a piece of new stuff. Here again I clap my chapped hands. Of all the bewildering and incomprehensible straits one can plunge into is that of the translator who gets mired down in a mess of sticky spun-out phrases. Those kind of coy revelations remind me of an amateur strip-tease artist—maybe one who really hasn't much to be modest about either. If there isn't anything worth exhibiting or telling, just say so and not try to bluff folks into accepting half-baked experiments as finished conclusions.

Novel ways of reaching the heart's desire in direct "mail-order" information to the masses are proposed for the future by several good research leaders, notably Dr. Vannevar Bush of Office of Scientific Research and Development, set up in 1941. He thinks that we have too much space devoted to bulky libraries and reams of dry matter. He wants it sorted over and dwarfed into microscopic proportions so that one's desk and mailbag won't be littered so heavily with random and often contradictory reports.

When one surveys the field of achievement, without taking stock of what we don't know anything about whatever, it simmers down to our having in recent years under national emergency explored the unknown to an extent never before attempted. The Government is not conducting all this work alone. There are over three thousand contracts with more than four hundred forty-five institutions involving the expenditure of over five hundred million dollars.

Obviously, this signifies a private and public teamwork which needs to be carried along through fruitful peace years, possibly with the new Food and Agriculture Organization leading in

much of its development, extension, and translation. Having won out on a slim margin ahead of the grim Germanic scientific oligarchy, it's vitally necessary to proceed from the threshold of victory into the calm and possibly indifferent era of peace with full steam ahead to conquer hunger and mal-distribution of the world's resources.

We have imagined fondly for years that the rural dweller was favored of the earth in terms of content and happy human welfare. But if we define rural dwellers as all humanity everywhere close to the earth, we soon learn that two-thirds of the two-thirds of the world's people who live rurally are suffering from a form of dietary "atrocity" which is just as sure to kill as the kind those prison pictures revealed this spring.

The late General Hugh Johnson was wont to comment forcibly upon the plight of those who worked in the limelight of public employment and whose actions were subject to scrutiny and criticism like fish in a glass bowl. A parallel can be drawn therein between the research worker attached to a government agency and another who is responsible only to a corporation or an endowment. It is clear that in the use of funds or the frequency of explanatory reports your test-tuber on the public payroll has a disadvantage under which the sheltered scientist seldom operates.

MOREOVER, it is a too-oft forgotten axiom that the personnel of a research organization must not be subject to direct bossing by a go-getting production and sales department. Your production and sales force is tempted to "egg on" the research folks to speed up things in general so that cute and dynamic advertising may be designed dollar-wise. This leaves the harried researcher in a panic and his mistakes and half-baked conclusions multiply under such commercial pressure.

When we speak of "imagination" in this connection we often make the error of thinking that it is the far-sighted, lively, and grasping production-sales outfit which possesses it for dazzling forays into the future to get ahead of a competitor. That may be true, for one particular brand of imagination. But the researcher claims another form of imagination no less real and purposeful. It is speculative, erratic, and often contradictory. It goes in one direction today and veers to the opposite tomorrow. You can't tie it down and rope it like a lay-out man throws a loop over some sales scheme. But in spite of this there is no excuse for any scientific department to become crusted over with layers of inertia and manifest no response to the urgency of reaching a definite objective.

LEST we become too owly in pursuit of this theme, let's relax and consider a type of research announcement which catches and holds the attention by unusual qualities. Of course, one hesitates to recommend using this approach too frequently.

A certain professor of dairy husbandry in the Northwest whose friendship I boast is not averse to playing up some fanciful opinions in the course of his lecture trips that take him far and wide among the teat-pulling fraternity. His main stunt is to teach productive milking methods and the theory of milk secretion. Just lately his talks have been enlivened by such keen sidelights as this:

"We have given little study to the behavior of cows. Within a given herd there is a society or well-established order. We must get the practical importance of catering to this. For instance, there is always a boss cow. Her society position has been established by combat. She fights for her society and the best fighter wins. She is first at the barn door or at the gate. She is usually not a problem cow. She is well adjusted and satisfied with her place. Then there are those that are neurotic and psychopathic within their own order and in relation to humans. They are maladjusted and hard to handle.

LaMOTTE SOIL TESTING SERVICE

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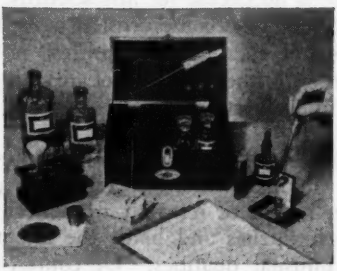

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This outfit makes it a simple matter to determine accurately the pH value or to know "How acid or how alkaline" your soil is. It can be used on soils of any texture or moisture content except heavy clay soil. Complete with LaMotte Soil Handbook, $10.00 f.o.b., Towson.

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In a herd there is just as much desire for social climbing as in human society. The society that a cow picks in a herd and her attitude toward fellow members is conditioned by the association she has with humans."

Then there comes to mind the Chicago physiology professor who has just revealed that Americans should learn to like cow feed. He says that cows eat the best feed while humanity only takes the scraps. He claims that we have adulterated every feed we eat except oatmeal and before long that will be messed around with. He says men toss away the germ while cows eat whole grain. Animals seem to know it automatically, he says, while man doesn't seem to care a whoop. He goes on further to explain if men had followed the method of the cud-chewing cow they would not be obliged to tighten their belts and put Secretary Anderson on the spot to keep them in balanced chow. I might go him one better while we are at it and remark how fortunate it is that humanity does not need to satisfy the hunger pangs of a paunch, reticulum, omasum and abomasum during this dilemma. Or have to worry about that many more spots in which to acquire ulcers.

IN this field of issuing thought provoking ideas and stirring speculative theories you must remove your hats to the researcher. Often the public is not informed well enough about his mental processes and hence gets no behind-the-scenes revelations. Too often any such lively and unusual claims are deemed too bizarre for the cloistered scientist. Yet he and his ilk should remember that what looked like crazy business a few years ago is normal procedure in many things today. In fact, the crazier the idea the more apt it is to survive the pressure of competition.

So I remain firm for public recognition of research, but to secure that widespread respect and support the realm of science needs the deft touch of those who will play the role of John the Baptist.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Sweet Potatoes (General)
Fertilize Potatoes for Quality and Profits (Pacific Coast)
Fertilizing Small Fruits (Pacific Coast)
Better Corn (Midwest) and (Northeast)
Fertilize Pastures for Better Livestock (Pacific Coast)
Of Course I'm Interested (Pastures, Canada)
Meet the Family (Canada)

Reprints

T-8 A Balanced Fertilizer for Bright Tobacco
N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
K-4-41 The Nutrition of Muck Crops
B-1-42 Growing Ladino Clover in the Northeast
E-2-42 Fertilizing for More and Better Vegetables
S-6-42 A Comparison of Boron Deficiency Symptoms and Potato Leafhopper Injury on Alfalfa
FF-11-42 Boron in Agriculture
H-12-42 Wartime Contribution of the American Potash Industry
JJ-12-42 The Place of Boron in Growing Truck
A-1-43 The Salt That Nearly Lost a War
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J-2-43 Maintaining Fertility When Growing Peanuts
M-3-43 Lespedeza Is Not a Poor Land Crop
S-4-43 Plow-Sole Fertilizers Benefit Tomatoes
W-4-43 The Soil Is the Basis of Farming Business
X-5-43 Malnutrition Symptoms & Plant Tissue Tests of Vegetable Crops
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
BB-6-43 Sericea Is A Good Crop
FF-8-43 Potash for Citrus Crops in California
PP-12-43 Commercial Fertilizers for Livestock Farms
QQ-12-43 Potash in War Production
A-1-44 What's in That Fertilizer Bag?
E-2-44 Plow-Sole Fertilizers Increase the Profits
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H-2-44 Efficient Fertilizers for Potato Farms
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K-3-44 Soil Tests Indicate Potash Levels
L-3-44 South Finds Clovers Excel in Profits
N-4-44 The Potash Problem in Illinois
P-4-44 Borax Sprayed on Beets Controls Black Spot
R-5-44 More About Soybean Fertilization
T-5-44 Southern Crops Show Need of Potash
W-6-44 Fertilizer Requirements for Permanent Pastures in Alabama
X-6-44 Soil Management for Cannery Peas
Y-6-44 Sweet Clover Responds to Potash Fertilizer
Z-6-44 Our Fertilizers Need Magnesium
AA-8-44 Florida Knows How to Fertilize Citrus
BB-8-44 Potash for War Food
CC-8-44 Soil Fertility's Effect on Asparagus
DD-8-44 Keeping Soil Fertile in the Pecan Orchard
EE-8-44 The Need for Borax on Fourteen Crops
KK-11-44 Growing Quality in Tomatoes
MM-12-44 Blue Lupine Is a Valuable Legume
PP-12-44 Fitting Practices to Soil Conditions
QQ-12-44 Leaf Analysis—A Guide to Better Crops
A-1-45 Fertilized Corn Plants Require Well-Ventilated Soils
C-1-45 Fertilizers for Cotton and Corn Following Lespedeza
E-1-45 Bigger Yields from Fertilizers
F-2-45 Defective Strawberry Fruit Corrected by Borax
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K-2-45 Plow-Sole Fertilizing on the Average Farm
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THE AMERICAN POTASH INSTITUTE

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First wife: "Does your husband play cards for money?"

Second one: "I don't think so, but those who play with him do."

A teacher was attempting to explain to the class the difference between abstract and concrete, and was doing her best to make the explanation very simple and clear. "Now," she said, "concrete is something that you can see and abstract is something that you cannot see."

A little boy looked quite enlightened, so the teacher ventured to test her explanation. "George," she said, "give me the explanation of something concrete."

"My pants," was George's reply.

"Correct," said the teacher. "Now give me an example of something abstract?"

"Yours," gleefully answered George.

"Eph, did yo' all know dat Jonah done spent three days in de stomach ob a whale?"

"Humph! Dat ain't much. Mah uncle wuz longer dan dat in de stomach of a alligator."

"Sho enuf! How long?"

"He dar yit."

A wealthy man, intent on matrimony, told his friend one day that he was sixty years old, and asked, "Would it be better if I told a young lady whom I'd like to marry, that I'm only fifty?"

"I'll be perfectly frank with you," his friend replied. "Your chances would be better if you'd tell her you were seventy-five."

Son—"What's an optimist, Dad?"

Dad—"An optimist is a man who thinks his wife has quit smoking cigarettes when he finds cigar butts around the house."

No one pays any attention to a watermelon rind, but when it's a peach peeling that's different.

Sign in front of a Marrying Justice of the Peace: You furnish the bride, we'll do the rest.

Bashful Groom: "That's hardly fair."

Tramp—"I ain't got a friend nor a relative in the world, mum."

Housewife—"Well I'm glad there's nobody to worry over you, in case you get hurt. Here, collie, sick 'im."

Jack: "How can you tell if a woman really loves you?"

Jim: "If she really loves you, you can make her do anything she wants to."

Drill Sergeant to Rookie—"Wipe that opinion off your face!"

A housewife had just employed a negro cook with the understanding that she was not married. Next morning the cook arrived with four little darkies trailing after her.

"But I thought you said you were not married," said the good housewife.

"Ah ain't, mam, but ah ain't been neglected, neither."

Many a married couple is like a team of horses—separated by a tongue.

Need for—

BORON IN AGRICULTURE

Authorities have recognized that the depletion of Boron in soil has been reflected in limited production and poor quality of numerous field and fruit crops.

Outstanding results have been obtained with the application of Borax in specific quantities or as part of the regular fertilizer mix, improving the quality and increasing the production of alfalfa and other legumes, table beets, sugar beets, apples, etc.

The work of the State Agricultural Stations and recommendations of the County Agents are steadily increasing the recognition of the need for Boron in agriculture. We are prepared to render every practical assistance.

Borax is economical and very little is required. It is conveniently packed in 100 lb. sacks and stocks are available for prompt delivery everywhere in the United States and Canada. Address your inquiries to the nearest office.

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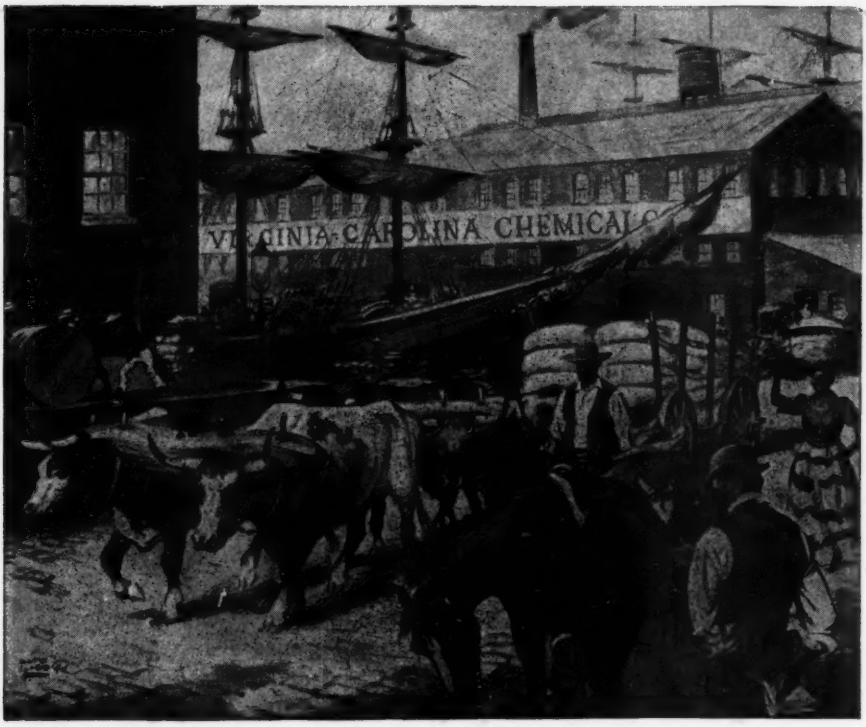

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Today, through its network of 34 fertilizer factories, its phosphate rock mines, its 20 sulphuric acid plants, its 26 superphosphate producing units, its chemicals division and its analytical and research laboratories, the V-C organization serves farmers in every state from the Rocky Mountains to the Atlantic and from Canada to the Gulf of Mexico.

Today more V-C customers are using more V-C Fertilizers than ever before in history . . . their total crop production is greater than ever before in history . . . and their cash farm income is higher than ever before in history.

It is fitting and proper that V-C's 50TH ANNIVERSARY should find V-C Fertilizers rendering their greatest service to the American farmer.

VIRGINIA-CAROLINA CHEMICAL CORPORATION

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VC FERTILIZERS

Useful Information for the Busy County Agent

Today the County Agent is guide and mentor to millions. His job of helping farmers grow better crops has taken on new proportions. Now he is directly responsible for the success of Victory Gardeners who are doing so much to increase America's food supply.

One subject on which the County Agent wants to be well-informed is the protection of seed against soil-borne and seed-surface fungi. Seed protection is important in any season—and is especially important in a cold, wet planting season like the one just past.

Write today for latest reports on the use of Spergon to protect seed; increase emergence; stimulate growth; improve stands and yields. Information about this non-injurious, easy-to-use seed treatment deserves a place in your working library.

Advantages of Spergon

- Safe to use—cannot harm delicate seeds, even when used in excess.
- Safe for user—non-poisonous and non-irritating to those applying it to seed.
- Long lasting—Spergon does not deteriorate with age; may be applied months in advance of planting.
- Self-lubricating. No graphite needed in drill.
- Compatible with legume inoculants.

TYPICAL DOSAGES

Corn	1½ oz. per bu. seed
Peas	2 oz. per bu. seed
Beans (including Limas)	2 oz. per bu. seed
Soybeans	2 oz. per bu. seed
Sorghum	1½ oz. per bu. seed
Flax	2 oz. per bu. seed
Peanuts	3 oz. per 100 lbs. seed

Spergon

Reg. U. S. Pat. Off.

SEED PROTECTANT

UNITED STATES RUBBER COMPANY

Naugatuck Chemical Division

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

Serving Through Science

THE PLANT SPEAKS

A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

THE PLANT SPEAKS, SOIL TESTS TELL US WHY depicts taking soil samples on the farm and the interpretation of soil tests. (Running time 10 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)

We shall be pleased to loan these films to agricultural colleges, experiment stations, county agents, vocational teachers, responsible farm organizations, and members of the fertilizer trade.

OTHER 16MM. COLOR FILMS AVAILABLE FOR TERRITORIES INDICATED

Potash in Southern Agriculture (South)
In the Clover (Northeast)
Bringing Citrus Quality to Market (West)
Machine Placement of Fertilizer (West)
Ladino Clover Pastures (West)
Potash from Soil to Plant (West)
Potash Deficiency in Grapes and Prunes (West)
New Soils from Old (Midwest)
Potash Production in America (All)
Save That Soil (All)

IMPORTANT

Requests should be made *well in advance* and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of time of loan.

American Potash Institute
1155 Sixteenth Street
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